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ORIGINAL ARTICLES.

I.—A Retrospect of Palæontology in the last Forty Years.

(*Continued from the February number, p. 56.*)

Polyzoa, etc.—Among our early contributors stands the well-known name of George Busk, author of a "Catalogue of Polyzoa in the British Museum" (1852–54) and a most valuable monograph on the "Polyzoa of the Crag" (Pal. Soc., 1859). Busk sent a paper (in 1866) to this Magazine on "Polyzoa from the London Clay of Highgate," describing three genera and species new to science. Professor H. A. Nicholson wrote on *Callopora incrassata* from the Devonian of Canada; on *Heterodictya* from the Devonian of Ontario; and on the geological distribution of *Solenopora compacta* (1885). Professor Dr. Ferdinand Roemer (in 1880) recorded the genus *Caunopora* in the Devonian of South Devon. Robert Etheridge, jun. (1873), figured and described *Carinella*, a new genus from Carluke, Lanarkshire, and *Ramipora* from the Caradoc Beds of Corwen, North Wales. G. R. Vine discoursed on Carboniferous Polyzoa (in 1880); F. D. Longe on Oolitic Polyzoa (in 1881); and Dr. J. W. Gregory on some Jurassic species of Cheilostomata (in 1894).

Brachiopoda.—The historian of the Brachiopoda, Dr. Thomas Davidson, who finished his great work in 1885, and who was equally facile with pencil and pen, was a large contributor to the pages of our journal for twenty years. His great monograph on British Brachiopoda, published by the Palæontographical Society, fills five large quarto volumes, illustrated by over 200 plates drawn by the author's own hands. He was author of the article *Brachiopoda* for the "Encyclopædia Britannica," and monographed the specimens collected by the "Challenger" expedition. He wrote in this Magazine on the genus *Thecidium* (1864); on perforate and imperforate Brachiopoda (1867); on the earliest forms of Brachiopoda in British Palæozoic rocks (1868); Italian Tertiary Brachiopoda (1870); Tertiary species from Belgium, and on the genus *Porambonites* (1874); Scottish Silurian Brachiopoda, and on "What is a Brachiopod?" (1877); on those of the Boulonnais (1878); on Lower Llandeilo forms from Brittany (1880); on

spiral-bearing forms and on the genus *Merista* (1881); on Scottish Silurian species (1883); also joint papers with Professor W. King on *Trimerella*, *Dinobolus*, and *Monomorella*; and with George Maw on Silurian Brachiopoda from Shropshire. Professor E. Ray Lankester (1870) wrote on a new large *Terebratula* from the Drift of Suffolk, which he named *Terebratula rex* (p. 413). C. J. A. Meÿer (1864) on the Lower Greensand Brachiopoda, Surrey; (in 1868) on the development of the loop and septum in *Terebratella*; Professor William King (1867) on perforated Palæozoic Spiriferidæ. John Francis Walker, in the same year, described new Terebratulidæ, *Waldheimia Davidsoni*, *W. Woodwardi*, and *T. Dallasii*; and in 1868 twelve other species of Brachiopoda, all from the Lower Greensand of Upware; he added two varieties of *T. depressa* and two new species, *T. Seeleyi* and *Rhynchonella Crossii*, also from Upware, in 1870. That author noticed (1878) the occurrence of *T. Morieri* in England, and in 1892, the discovery of *T. substriata* near Scarborough, Yorkshire. The well-known Canadian palæontologist Elkanah Billings (born 1820 and died 1876) achieved admirable work in his busy life in monographing Corals, Brachiopoda, Crinoids, Trilobites, Graptolites, and plants (see Decades of Survey on "Canadian Organic Remains"). He contributed an excellent paper and plate in 1868 on *Stricklandinia Davidsoni* and *S. Salteri* (p. 59). Professor G. Lindström, of Stockholm, wrote on the genus *Trimerella* (in 1868); the Rev. N. Glass described the modifications in the spirals of fossil Brachiopoda (1888), and of the loop in *Athyris lævinscula* (1891); S. S. Buckman had a paper on Jurassic Brachiopoda in 1886; E. Westlake on *Terebratula* from the Upper Chalk of Salisbury in 1887; Dr. John Young on the minute shell-structure of *Eichwaldia Capewelli*, and on the shell-structure of *Chonetes Laguessiana* from the Lower Carboniferous Limestone series of Lanarkshire. Dr. A. H. Foord noticed West Australian Brachiopoda; J. L. Lobley the range of British fossil Brachiopoda; R. Bullen Newton (1892) wrote on *Chonetes Pratti* from the Carboniferous rocks of West Australia; F. R. Cowper Reed on some abnormal forms of *Spirifera lineata*, Martin (1893), and on *Eumetria* (?) *serpentina*, a Carboniferous Brachiopod new to Britain (1898). Dr. G. F. Matthew described and figured the oldest known *Siphonotreta* (*Protosiphon*) *Kempanum* from Cambrian, Division 1*b* of the St. John Group, N.B. Canada (1897). Agnes Crane gave, in a clever paper, the evolution of the Brachiopoda (1895); and R. Etheridge noticed the fossils of the Red Beds, Lower Devonian, Torquay (1882).

Mollusca.—Many of the earlier and more important papers on Mollusca dealt with this class from a geological aspect, such as that by R. D. Darbishire (1865) on the fossil shells obtained from the Drift-beds of Macclesfield. The author refers to the Moel Tryfaen shells near Carnarvon at 1,350 feet above sea-level, from which 60 species of mollusca were obtained; to those of Gynn, between Blackpool and Fleetwood, Lancashire. The highest points about Macclesfield discovered by Sir J. Prestwich was at the Setter Dog Inn, on the Buxton Road, 1,200 feet above sea-level. Mr. Darbishire's

specimens were obtained from the Free Park Cemetery, Macclesfield, where about 50 species were collected.

Dr. S. P. Woodward wrote (in 1864) on *Plicatula sigillina* from the Upper Chalk of Cambridge, and on the fossil shells from the Bridlington Crag (1864); 44 species were enumerated. In a later list (1881) supplied by C. W. Lamplugh, some 67 species were recorded. An admirable memoir by Mrs. McKenny Hughes was contributed in 1888 on the Mollusca from the Pleistocene Gravels of Barnwell, Cambridge, which dealt with both the geology and the shells, 80 species being accurately listed, also many other forms both of vertebrate, invertebrate, and plant-remains. G. Sharman and E. T. Newton (in 1896) recorded the occurrence of Cretaceous fossils in the Drift of Moreseat, Aberdeen, of which they gave a carefully prepared list of 40 species of Mollusca, besides Brachiopoda, Echinodermata, etc. A. J. Jukes-Browne (in the same year) noticed the fossils from the Warminster Greensand. J. Starkie Gardner (1873 and 1875) described the genus *Aporrhais*, and noticed other Gault Gasteropoda in a series of six papers (1876, 77, 84, 85). H. Woodward figured *Rostellaria Pricei* from the Grey Chalk, and F. G. H. Price *Rostellaria maxima* from the Gault, both extracted from the Folkestone cliffs. W. H. Hudleston discoursed on the Palæontology of the Yorkshire Oolites (1880), and on the Gasteropoda of the Portland Beds of the Vale of Wardour (1881). Edward Wilson (1887) figured and recorded 15 new species of Liassic Gasteropoda, and with W. D. Crick in 1889 wrote on the Gasteropoda from the Lias Marlstone of Tilton. E. Wilson also published in 1890 a list of types in the Bristol Museum; H. E. Quilter (1886) fossils from the Lower Lias of Leicestershire; and R. Tate from the Lias of Banbury (1875). Dr. John Lycett discussed (in 1881) the generic distinctness of *Purpuroides* and *Purpura*. R. Etheridge, jun., described (in 1873–74) new species of Lamellibranchiata from the Carboniferous of Scotland, the genus *Conularia* (1873), *Modiola lithodomides* (1875), and contributed five other papers (1876–79) on Carboniferous Mollusca. F. R. Cowper Reed (1901) figured and noticed some of Salter's undescribed Mollusca in the Woodwardian Museum.

The first article in 1864 was by J. W. Salter on the fossils from the Old Red pebbles at Budleigh Salterton. H. Woodward wrote upon an Upper Silurian *Chiton* from the Girvan district, upon recent and fossil *Pleurotomariæ* (both in 1885), and on *Pleurotoma prisca* (1901). The Rev. G. F. Whidborne described in the same year some Devonian fossils from Devonshire. Ralph Tate (in 1868) defined the genus *Axinopsis*. In 1871 Professor J. W. Judd gave an interesting account, with figures, of the anomalous mode of growth of certain oysters from the Cornbrash of Scarborough, Weymouth, and Peterborough, parasitic on Ammonite shells, etc. R. B. Newton contributed a paper on the genus *Leveillia*. F. E. Edwards (in 1865) described some new species of *Cypræa* and *Marginella*. In 1902 General McMahon and W. H. Hudleston figured a series of fossils from the Hindu Khoosh, and the latter communicated

(1884 and 1890) two papers on fossil Mollusca from South Australia. Professor T. Rupert Jones (1890) described bivalved shells from the Karoo formation of South Africa; R. B. Newton (1898–99) some Cretaceous and Miocene shells from Egypt; a large number of Pleistocene shells from a raised beach on the Red Sea (1900); Mesozoic fossils from Borneo (1897); and lastly, *Trematonotus*, an American Palæozoic Gasteropod, found in Britain (1892). R. J. L. Guppy gave a list of Tertiary fossils from Trinidad (1865); described *Crepitacella* and six new species of Mollusca from the Caribbean Miocene (in 1867); and some West Indian Tertiary fossils, chiefly Mollusca (in 1874). H. Woodward (in 1879) described a series of 74 species of Tertiary Mollusca, obtained by M. Verbeek from Sumatra (pp. 385, 441, 492, 535). Dr. A. H. Foord (1890) figured a number of fossils from the Kimberley District of Western Australia. H. M. Jenkins (1866) wrote on *Trigonia* from the Tertiary deposits of Victoria, Australia; and Professor M'Coy replied to his criticism on the species of *Trigonia*. Dr. O. A. L. Mörch (in 1871) described the Mollusca of the Crag formation of Iceland, giving a list of 61 species. "At present" (wrote Dr. Mörch) "the north coast of Iceland is *quite Arctic*, but in the Crag period the temperature must have been much milder, at least as mild as at present on the west coast of Reikiavik." The change had, the author believed, resulted from an elevation of the land, which had prevented the free passage northwards of the great equatorial current of the Gulf Stream. Sir J. Prestwich wrote, in 1882, on *Cyrena fluminalis* found at Summertown, near Oxford, and R. G. Bell, in 1884, on Land-Shells from the Red Crag.

Cephalopoda.—During the past forty years the class Cephalopoda received special attention from many expert writers, as will be seen from the following summary:—An excellent general history of the Cephalopoda, Recent and Fossil, was contributed in 1878 by Agnes Crane, which may still be read with pleasure and profit. In 1887 Dr. F. A. Bather wrote on "The Growth of Cephalopod Shells," and carefully described and figured the internal structure of the shell, giving his own views on the subject as well as Dr. Riefstahl's. Another article of general interest was that communicated by Dr. A. H. Foord describing the Cephalopod Gallery of the British Museum (Natural History), Cromwell Road (1895, p. 391), illustrated by 27 figures; it still serves as an excellent guide to the series of Ammonites exhibited. Among the dibranchiate forms abundantly represented among the living Cephalopoda, but so rare in a fossil state, there is a charming little form which was figured and described by H. Woodward under the name of *Dorateuthis syriaca*, from the Cretaceous beds of Sahel Alma, near Beirût, Lebanon, Syria (1883). Other and larger forms have since been recorded by that author and by G. C. Crick from the same locality. The remarkable thing is the preservation on the slab of the outlines and much of the details of the soft structures of the animal as was observed in *Belemnoteuthis* and other forms from the Oxford Clay of Chippenham, and described in 1842 by Pearce & Owen. G. C. Crick

wrote in 1901 upon *Ammonites Ramsayanus* from the Chalk of Chardstock, Somerset; *A. euomphalus* (1899) from the Lower Chalk, near Lyme Regis, collected by Dr. Rowe and Mr. C. D. Sherborn; and on a deformed *Hoplites* from the Gault of Folkestone. Messrs. Foord & Crick wrote (in 1891) on the identity of *N. neocomiensis* with *N. Deslongschampsianus* from the Grey Chalk, and on *N. elegans* from the Lower Chalk and Greensand (1890). Dr. Blackmore (in 1896) endeavoured to prove that some of the bodies known as *Aptychi*, from the Chalk of Salisbury, belonged to Belemnites. His conclusion was that (1) *Aptychus rugosus* is the pro-ostracum of *Belemnitella mucronata*; (2) *Aptychus leptophyllus* is the same part of *B. lanceolata*; (3) *Aptychus Portlockii* is the pro-ostracum of *B. quadrata*; (4) the large, coarsely punctate *Aptychus* from the Marsupite zone is the true *Aptychus* of *Ammonites leptophyllus*. E. H. L. Schwarz wrote on *Aptychus* in Ammonites, and supported the conclusion of S. P. Woodward (see *The Geologist*, 1860) and H. Woodward (Geological Magazine, 1885) that the *Aptychus* is really equivalent to the calcified and coalesced pair of dorsal arms which form the 'hood' or *operculum* in the living *Nautilus*. He has a second paper in 1895 on the shell-structure in the Ammonoidea. In 1886 S. S. Buckman wrote on the lobe-line of Lias Ammonites, in 1887 and 1889 he described some Jurassic Ammonites, and in 1894 he discussed the species belonging to the genus *Cymbites* from the Lower Lias of Lyme Regis. E. T. Newton wrote (in 1891) on *Ammonites jurensis* from the Ironstone of the Northampton Sands; G. C. Crick on some Jurassic Cephalopoda from Western Australia (1894), on *Coccoteuthis hastiformis* (1896) and *Acanthoteuthis speciosa* (1897), both from the Lithographic Stone of Solenhofen; he pointed out that *Nautilus truncatus*, referred to the Lias, really belongs to the Cornbrash; he defined *Ammonites calcar* from the Lower Oxfordian (in 1899), and *Ammonites polygonus*, *A. discoides*, and *Tmaegoceras* (1902) from the Lias, and a Jurassic Belemnite from Somaliland (1896). R. Tate discovered and recorded the oldest British Belemnite (*B. prematurus*) from the Lower Lias, Antrim (1869). A. H. Foord and G. C. Crick figured in 1889 the muscular impressions of *Cœlonautilus cariniferus*; described *Pleuronautilus* (1891); *Vestinautilus* and *Discites Hibernicus* in 1893; described and figured *Prolecanites*, *Temnochilus* from the Carboniferous of Cork, Ireland, in 1894; and *Nautilus robustus* from the Middle Lias of Les Moutiers, Normandy, in 1902. G. C. Crick wrote on *Goniatites evolutus* and *Nautilus tetragonus* in 1896, and *Ephippioceras* (1900); and A. H. Foord figured *Acanthonautilus bispinosus* (1897). F. R. Cowper Reed described *Pleuronautilus Scarlettensis*, sp. nov., from the Carboniferous Limestone of the Isle of Man, in 1900. F. Roemer (1880) and J. E. Lee (in 1877) noticed the occurrence of *Goniatites*, etc., in the Upper Devonian of Torbay. The late Professor H. A. Nicholson gave, in 1872, a description and figure of *Endoceras proteiforme*, Hall, from the Coniston series (Silurian), Skelgill Beck, Ambleside. Dr. A. H. Foord (1887) wrote on Salter's genus

Piloceras from the Tremadoc Slates, and on the perforated apex and siphuncle of *Actinoceras* from the Black River Formation (Silurian), Canada. Professor G. Lindström (1888) described Barrande's genus *Ascoceras* from the Upper Silurian of Gotland, and announced the discovery of an earlier or *Nautilus* stage in the growth of this Cephalopod shell, which was evidently decollated in the later period of its life, leaving the *Ascoceras* form behind. This was more fully illustrated by Dr. A. H. Foord (in 1889). The earlier part of the shell seems to have been composed of a series of air-chambers, which were periodically thrown off by natural truncation. It is interesting to notice that some modern land-shells (e.g. *Bulimus decollatus*) throw off the apex of their spiral shells, living afterwards in a truncated shell, the top of which is closed by a diaphragm. In 1891 Dr. A. H. Foord discussed *Orthoceratites vaginatus*, Schl., from the Silurian of Sweden; and in 1903 G. C. Crick described some new forms of *Orthoceras* from the Silurian of the Province of Shantung, North China. In 1897 Dr. Gerhard Holm figured *Baltoceras*, a new genus of Orthoceratitidæ from the grey *Lituites* Limestone of the I. of Öland, a form of *Orthoceras* with a marginal or sub-marginal siphon.

Pisces.—In our retrospect of Vertebrate Palæontology we find in the Geological Magazine a vast store of most important contributions to all the great sections, that of fossil fishes being particularly rich and varied. Foremost among writers in Ichthyology stands the name of the veteran zoologist, Dr. Albert Günther, who from 1856 to 1895 devoted himself specially to the study of Reptiles and Fishes in the British Museum, and was Keeper of Zoology for 20 years (1875–95). He wrote a description in vol. i, 1864, of a new fossil fish from the Lower Chalk of Folkestone, which he named *Plinthophorus robustus*; and in 1876 described 10 species of fishes from the Tertiary Marl-slates and Carbonaceous shales of the Padang Highlands, Central Sumatra, collected by R. D. M. Verbeek, illustrated by five large folding plates. Our old chief, Professor Owen, who for 27 years (1856–83) held the post of Superintendent of the Natural History Departments in the British Museum, contributed numerous papers to the Magazine, six being devoted to fossil Ichthyology. In 1865 he described a jaw of *Stereodus melitensis* from the Miocene of Malta; he figured and named a sauroid fish from the Kimmeridge Clay, Oxfordshire, *Ditaxiodus impar* (1866); *Thlattodus suchoides* from the same horizon at Downham, Norfolk. In 1867 he made a large number of genera and species of fishes from the coal-shales of Northumberland; many of these minute fish-remains were later on (p. 379) suggested to be dermal ossicles of large fishes, and others to be the teeth of fishes already described by Agassiz and others. In 1869 Owen noticed a fine jaw of *Strophodus* from the Oolite of Caen, Normandy, a fossil shark closely related to the living Port Jackson shark, *Cestracion Philippi*, of which a woodcut was given on p. 236. He also described and figured a spine of *Lepracanthus Colei*, from the Coal-measures, Ruabon, North Wales (1869). Professor Ray

Lankester, now Director of the British Museum of Natural History, began in 1867 to write on fossil fishes, and described a new Cephalaspid (probably an *Auchenaspis* from Malvern); *Didymaspis Grindrodi* from the Lower Old Red of Ledbury; a new *Cephalaspis* (*C. Dawsoni*) discovered in Lower Devonian beds, Gaspé Bay, Canada (1870); and on *Pteraspis* and *Scaphaspis* (1873–74). In 1873 Professor Dr. Frederic Schmidt had a note on *Pteraspis Kneri*, pointing out that *Scaphaspis* is the ventral shield of *Pteraspis*! Lankester wrote also (in 1873) on *Holaspis sericeus* from the Cornstones of Abergavenny, and on the relationships of *Pteraspis*, *Cyathaspis*, and *Scaphaspis*; and on *Holaspis* (p. 331) and *Pteraspis* (p. 478). J. E. Lee described (1882) some Pteraspidean plates from the Devonian of Gerolstein, in the Eifel; and H. Woodward (1881) figured a head-shield of the genus *Zenaspis* from Old Red, Abergavenny. An old and highly esteemed member of the Staff of the Geological Department, William Davies, in 1871 contributed a catalogue of the type-specimens of fossil fishes in the British Museum. (A list of the 'types' in the Egerton Collection appeared in 1869, and those of the Enniskillen Collection in the same year. Both these most valuable collections have been acquired for the nation, and are now added to the Geological Department.) An important paper by William Davies was published in 1872 on the rostral prolongations of *Squaloraia polyspondyla*, Ag., from the Lower Lias of Lyme Regis; these are organs for holding the female, being only present in the male, and correspond to the rostral claspers of the male Chimæridæ. The frontal spine and rostro-labial cartilages of *Squaloraia* and *Chimæra* formed the subject of an important paper by O. M. Reis in 1895, in which a large amount of anatomical details was given, with careful figures and sections. Mr. Davies wrote also (1878) on *Saurocephalus lanciformis* and *S. Woodwardii* from the Chalk of Kent and Sussex, and on *Pholidophorus purbeckensis* and *P. brevis* from the Purbeck of Dorset. E. C. H. Day (1864) described and figured a very beautiful and perfect jaw of *Acrodus Anningiæ*, and dorsal spines belonging to the same shark, which must have been closely related to the living Port Jackson shark, having the mouth provided with numerous rows of crushing teeth (known by the quarry men as 'fossil slugs'). Sir Philip Egerton (1877) defined four species of Pycnodonts: *Cœlodus ellipticus*, Gault, Folkestone; *C. gyrodoides*, Greensand, near Lyme; *Pycnodus Bowerbankii* and *P. pachyrhinus*, both from the London Clay, Sheppey; illustrated by two excellent plates. James Powrie, of Reswallie, Forfarshire, wrote (1867) on the genus *Cheirolepis* from the Old Red Sandstone. T. P. Barkas figured teeth of *Ctenodus* from the Coal Shale of Newsham Colliery; and our old colleague, Professor John Morris, figured and described *Æchmodus orbicularis* from the Lias of Lyme Regis. The Rev. Professor E. R. Lewis, of the Syrian Protestant College, Beirût, gave (in 1878) an excellent account of the localities in the Cretaceous beds of the Lebanon where fossil fishes could be obtained. His collection from Hakel and Sahel Alma now enriches the British

Museum Geological Collection. In 1886 James William Davis noticed a number of teeth of fishes from Tertiary beds of New Zealand, comprising *Lamna, Carcharodon, Notidanus, Myliobatis*, etc. He gave a further note on New Zealand Tertiary fishes in 1888, which he referred to the genus *Scymnus*. He recorded thirteen species of fish-remains from the Carboniferous Limestone of Derbyshire, mostly palatal teeth of *Petalodus, Petalorhynchus, Streblodus, Psephodus*, etc. This bright and promising naturalist and geologist passed away at the early age of 47 years, a victim to overwork. A very interesting Ichthyodorulite named *Edestus Davisii*, discovered on the Gascoyne, Western Australia, was figured and described by Henry Woodward in 1886; this form is now supposed to be the coiled dentition of a Carboniferous shark. Entire coiled examples have been obtained from deposits of similar age in Russia by A. Karpinsky.

Nearly fifty separate papers on fossil fishes have been contributed by two authors in about equal proportions. Dr. R. H. Traquair's extended over 31 years, from 1871 to 1902, and number twenty-three; Dr. Arthur Smith Woodward's over 17 years, from 1886 to 1903, and number twenty-two.

Dr. Traquair's first paper, in 1871, dealt with the genus *Phaneropleuron* from the Lower Carboniferous (Burdiehouse Limestone) of Edinburgh, of which genus he gave an excellent plate and a restored outline (for Dr. Traquair, like Dr. Davidson, is equally facile with pen and pencil, his blackboard sketches as "Swiney Lecturer" being unsurpassed by anyone). In 1873 he described a new Dipnoid fish, *Ganorhynchus Woodwardi*; and in 1874 *Cycloptychius carbonarius* from the Coal-measures of N. Staffordshire. The fish-remains from Borough Lee, near Edinburgh, engaged Traquair's attention, when he published three papers (in 1881), and a fourth one, upon *Plenracanthus horridulus*, in 1882. In 1884 he wrote on *Ctenacanthus costellatus* from Eskdale, and on the genus *Megalichthys* from the Hugh Miller Collection; and in 1885 on *Psephodus magnus* from the Carboniferous Limestone of East Kilbride. In 1886 and 1888 Dr. Traquair wrote on the English Palæoniscidæ, and on *Chondrosteus acipenseroides*, a sturgeon-like fish from the Lias of Lyme Regis, in 1887; on Carboniferous sharks and on the nomenclature of Old Red Fishes in 1888; on *Homosteus* and *Coccosteus* and on *Dipterus macropterus* in 1889. In 1890 Traquair discussed in two papers the Devonian Fishes of Scaumenac Bay and Campbelltown, Canada, including very perfect remains of buckler-coated fishes like *Bothriolepis canadensis, Coccosteus, Cephalaspis*, and many other genera. He wrote again on fishes from Borough Lee (1890); on *Myriolepis* from the Kilkenny Coalfield in 1893, and on *Diplacanthus* in 1894. In 1900 Traquair gave restorations of *Drepanaspis*, a wonderful new Cephalaspid fish from the Devonian Slates of Gmünden in Western Germany, and he added further and corrected figures in 1902. His Address (1900) to the British Association (p. 463) on the bearings of fossil Ichthyology on Evolution was a very important

contribution to our science, and treated most philosophically by the author. In his paper on the Lower Carboniferous Fishes of Fifeshire, Traquair enumerated 37 fishes from the Calciferous Sandstone and Carboniferous Limestone series. These extraordinary fishes, with others from the Silurian of Lanarkshire (pp. 67–69, 1900), add to and complete a splendid record of Ichthyological research, to which must be added his memoirs in the Palæontographical Society's volumes and in those of the Geological Survey and elsewhere.

Science gained greatly when Arthur Smith Woodward, following in the steps of the veteran William Davies, took up the study of fossil fishes, for not only did he, by constant energy and perseverance, accomplish a vast amount of admirable work in this branch of science, but he was instrumental in inspiring his senior fellow-worker, Dr. Traquair, of Edinburgh, with a spirit of generous rivalry, which stimulated that very deliberate and careful anatomist to abandon his long accustomed habits of reserve and extreme caution, and to publish in an unusually brief time many new and important contributions to fossil Ichthyology. Dr. Arthur Smith Woodward commenced to write on fossil fishes in this Magazine in 1886, by giving an account of the Selachian genus *Notidanus*, a shark still living and extending back to the Lias; fourteen fossil species of which were duly recorded. Post-Liassic species of *Acrodus* and *Holocentrum* from Malta followed, also in 1887. A beautiful jaw of the Cretaceous shark *Synechodus* in the Brighton Museum was figured and described in 1888. A gigantic species of *Rhinobatis*, one of the Rays (commonly called 'old maids'), a Selachian fish from the Lithographic Stone of Bavaria, was delineated and noted by A. Smith Woodward; *Eurycormus grandis* and seven other British Jurassic fishes, and *Onychodus* from the Devonian of Spitzbergen, were recorded in 1889. In 1890 the same author described the head of *Eurycormus* from Ely; and remains of a huge fish, *Leedsia problematica*, from Peterborough. Fossil fish-teeth from the Cretaceous and Tertiary of Belgium and *Pholidophorus* from the Lias of Whitby were noticed in 1891; papers on Lower Devonian fish from New Brunswick, on the Devonian fish fauna of Canada, and on a fossil saw-fish, *Sclerorhynchus atavus*, from the Lebanon Cretaceous, followed in 1892. A gigantic Eocene Skate (*Myliobatis*) from Egypt, a Greensand Pycnodont fish (*Athrodon*), and other Upper Jurassic species appeared in 1893; a second British Jurassic *Eurycormus* in 1894; the fossil fish fauna of the English Purbeck beds, and Synopsis of Ganoid fishes of the Cambridge Greensand, in 1895; Wealden fishes in 1896; and as a companion to *Rhinobatis* a still grander specimen, a *Squatina*, the 'angel-fish' or monk-fish, a metre in length, most beautifully preserved, from the Lithographic Stone of Wurtemberg, showing the entire outline and skeleton of the fish; and lastly, a Carboniferous *Listracanthus* in 1903. In 1874 R. Etheridge, jun., described a *Petalorhynchus* from E. Kilbride; T. Stock a *Rhizodus* (nearly entire) from the Wardie shales (1881); the late J. C. Mansel-Pleydell a Purbeck *Histionotus* (in 1889).

J. H. Cooke recorded the remains of *Stereodon melitensis* from Malta (1891); E. T. Newton wrote on *Onychodus* from the Old Red of Forfarshire (1892); H. Bolton on *Listracanthus spinatus* from the English Coal-measures (1896); E. D. Wellburn on *Rhadinichthys* from the Coal-measures, Yorkshire (1900), and the fish fauna of the Millstone Grit (1901). Lastly, Professor C. R. Eastman wrote on a new *Edestus*-like form of fish-dentition named *Campyloprion*, from the Coal-measures of Nebraska, U.S., 1902.

(*To be concluded in our next Number.*)

II. — Sedgwick Museum Notes.[1]

By F. R. Cowper Reed, M.A., F.G.S.

(PLATE V.)

New Fossils from the Haverfordwest District.

THE recent gift to the Museum of a fine series of Lower Palæozoic fossils from the Haverfordwest area by Mr. V. M. Turnbull, M.A., who has personally collected them with much care, has at length provided us with the means of determining many of the interesting species which were mentioned without specific names (on account of their imperfect preservation) by Messrs. Marr and Roberts in their paper on this district.[2] The collections from which their lists were drawn up are in the Sedgwick Museum.

Several species new to science or to the locality can now be accordingly described, but others must still await the acquisition of better material.

I. Phacops Robertsi, sp. nov. (Plate V.)

A large number of specimens of a species of *Phacops* were collected by Messrs. Marr and Roberts from the Sholeshook Limestone and Redhill Beds, but the material was scarcely good enough for a sufficient diagnosis of specific characters. Mr. Turnbull's new specimens of the same form have now supplied this want.

Description.—Head-shield nearly semicircular or broadly parabolic, obtusely pointed in front, about twice as broad as long, gently convex from back to front, strongly convex from side to side with the cheeks bent down; anterior border present.

Glabella elongated, expanding gradually towards the front to about double the basal width; rather narrow in relation to head-shield, the base being only about a quarter its width; nearly three times as long as wide at base; sides nearly straight behind frontal lobe, converging posteriorly at about 20°; gently and uniformly convex, rising but slightly above cheeks.

Frontal lobe of glabella not reaching front margin of head-shield, with rounded lateral angles projecting slightly at the sides; about half

[1] The series of articles in this Magazine which have been long known as "Woodwardian Museum Notes" will in the future be continued under the title of "Sedgwick Museum Notes," in consequence of the removal of the geological collections at Cambridge to the new Sedgwick Memorial Museum.

[2] Q.J.G.S., vol. xli (1885), pp. 476–490.

as long as whole glabella or rather more; transversely subquadrate in shape, with arched front end; not rising above general level of rest of glabella, nor detached from it; lateral angles circumscribed by facial sutures. Three pairs of lateral glabellar lobes present; first pair the largest, triangular in shape, extending back along axial furrows to middle of eyes; second and third pairs of lateral lobes of subequal size, and with subparallel anterior and posterior sides.

Three pairs of lateral glabellar furrows present; the basal pair the strongest. First pair straight, obliquely inclined to axial furrows at about 45° or 50°, arising a little in front of eyes and extending inwards for about two-fifths of the width of the glabella on each side; scarcely widening at their outer extremities. Second pair equal in depth and width to the first, horizontal, nearly straight or slightly arched forwards, arising nearly opposite middle of eyes and extending inwards for about one-third or rather more of the width of the glabella on each side. Third or basal pair deeper than the preceding pair, horizontal or slightly oblique, straight, situated half-way between second pair and occipital furrow, and extending on each side inwards for about one-third of the width of the glabella.

Occipital furrow strong, arched forwards in middle. Axial furrows rather weak, especially round lateral angles of frontal lobe; diverging anteriorly at about 20° in a slight concave curve from base of glabella to anterior end of eyes, in front of which they sweep outwards round the frontal lobe, merging imperceptibly into the nearly obsolete marginal furrow of the head-shield.

Fixed cheeks with anterior wing much reduced in size owing to lateral projection and width of frontal lobe; posterior wing with a basal width equal to about one and a half times that of the glabella at its base; posterior margin gently arched; neck segment marked off by strong deep furrow dying out before reaching lateral margin; lateral marginal furrow nearly obsolete. Genal angles measuring about 60° or more, and furnished with small sharp spinules. Eye-lobes large, prominent, semicircular, horizontally extended at same level as glabella.

Facial sutures with anterior and posterior branches making angle of about 70°; anterior branches curve round, defining lateral angles of frontal lobe, and unite in regular convex curve in front of it, which they thus bound; posterior branches curve slightly forward in a sigmoidal manner from base of eye to cut lateral margin a little behind the level of second lateral glabellar furrows.

Free cheeks small, triangular, united in front by the narrow, flattened, horizontal anterior border of the head-shield. Eyes large, prominent, high, strongly curved, but not angulated; extending from a little behind first lateral furrows to third lateral furrows of glabella; distant from posterior margin of head-shield about two-thirds their length; nearly touching side of glabella at their front end, but more remote at their posterior end; lens-bearing surface steeply inclined or vertical, with about 30–35 vertical rows of lenses having 10–12 lenses in the middle rows. Surface of glabella

granulated, with small tubercles interspersed. Faint traces on the frontal lobe of the V-shaped mark found in *Chasmops*.

Thorax (imperfectly known) about twice as long as head-shield; axis regularly semi-cylindrical, prominent, convex, with slightly swollen lateral nodes on axial rings. Pleuræ strongly arched, with deep diagonal furrow; fulcrum situated about half-way out; extra-fulcral part sharply bent down and slightly curved forwards; extremities of pleuræ rounded.

Pygidium semicircular to semi-elliptical, gently convex, with regular margin. Axis prominent, convex, conical, tapering to a pointed extremity, not quite reaching posterior margin; composed of 9–11 rings, of which only the first 5–6 are usually well marked. Axial furrows straight, converging posteriorly at about 20°–25°. Lateral lobes gently arched downwards on each side, showing 5–8 regular, slightly curved pleuræ, dying out towards the margin and each with weak median pleural furrow. Border smooth, not crossed by pleuræ, but not marked off on upper surface by marginal furrow. Infra-marginal doublure (seen in casts) convex, of moderate width, extending inwards to tip of axis.

Dimensions.

	mm.
Length of head-shield...	18–20
Width of head-shield	36–40
Length of pygidium	13–23
Width of pygidium	22–33

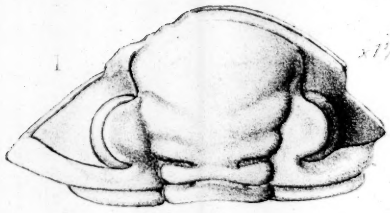
Affinities.—The general characters of this species indicate a close relationship to the Ordovician forms of *Dalmanites* (Barrande)[1] found in Bohemia. Hoernes[2] has carefully pointed out the characters which differentiate them from the typical Silurian and Devonian members of this genus as understood by Barrande, and they constitute a group which in one direction appears to lead to that of *D. Hausmanni* of Stages F, G, and H, and in the other direction to the typical forms of *Phacops*, sens. str., of the same Stages.

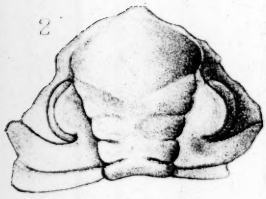
The chief points which distinguish this older group of *Dalmanites* are the rudimentary or absent frontal border, the slight separation of the frontal lobe from the rest of the glabella, the smallness or absence of the genal spines, the rounded or scarcely pointed extremities of the pleuræ, and the fewer segments in the pygidium.

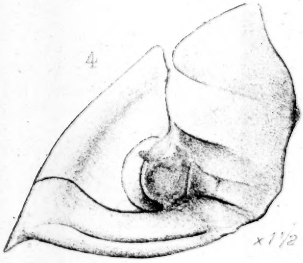
In *Ph. Robertsi* the head-shield with its distinct frontal border, the lobation and shape of the glabella, and small genal spines resemble those forms leading on to the *D. Hausmanni* group; but the rounded extremities of the pleuræ and the non-mucronate, semicircular pygidium connect it with the species which seem to be the ancestors of the typical *Phacops* group. *D. socialis*, Barr. (and its varieties), *D. Deshayesi*, Barr., and *D. Hawlei*, Barr.—all from Stage D in Bohemia—show strong points of resemblance in the head-shield, but *D. Phillipsi*, Barr. in the thorax and pygidium. It is

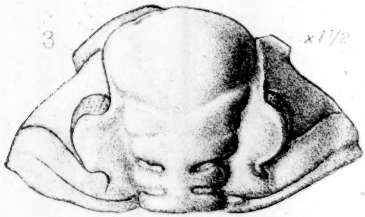
[1] Barrande: Syst. Silur. Bohême, vol. i, p. 299 et seq. and p. 528 et seq.

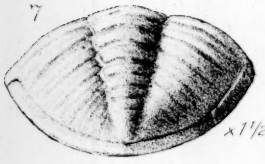
[2] Hoernes, Jahrb. Geol. Reichsanst. Wien, Bd. xxx (1880), Heft 4, pp. 651–680; and Kosmos, Jahrg. iv, Bd. viii (1880), pp. 20–32.

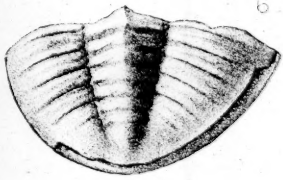


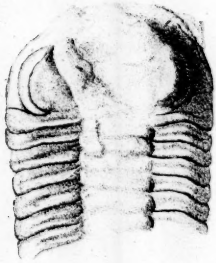












G.M. Woodward del. et lith. West, Newman imp.

Phacops Robertsi *sp. nov.*
Ordovician. *Haverfordwest.*

obvious, therefore, that this Haverfordwest species belongs to this group of *Dalmanites*, in which there existed a combination of the subsequently well-differentiated characters of the later typical *Dalmanites* and *Phacops*.

The specific name, *Ph. Robertsi*, has been chosen in memory of the late Mr. T. Roberts, M.A., F.G.S.

EXPLANATION OF PLATE V.

FIG. 1.—*Phacops Robertsi*, sp. nov. Head-shield. Redhill Stage, Prendergast Place, Haverfordwest. × 1½.
,, 2.—Ditto. Head-shield. Redhill Stage, Redhill Quarry, Haverfordwest. Nat. size.
,, 3.—Ditto. Head-shield. Sholeshook Limestone, Prendergast Place, Haverfordwest. × 1½.
,, 4.—Ditto. Free-cheek. Sholeshook Limestone, Prendergast Farm, Haverfordwest. × 1½.
,, 5.—Ditto. Head-shield with portion of thorax. Same horizon and locality. Nat. size.
,, 6.—Ditto. Pygidium. Redhill Stage, Redhill Quarry, Haverfordwest. Nat. size.
,, 7.—Ditto. Pygidium. Sholeshook Limestone, Prendergast Place, Haverfordwest. × 1½.

III.—Further Notes on the Mammals of the Eocene of Egypt.

By C. W. Andrews, D.Sc., F.G.S., British Museum (Natural History).

Part I.

DURING the last few months I have been engaged in examining the remains of the fossil Vertebrates from the Middle and Upper Eocene of the Fayûm district of Egypt, with a view to the preparation of the detailed monograph which it is proposed to publish on this subject. As it will be some months before this can appear, it seems desirable to give a brief account of some of the more important results arrived at, and preliminary descriptions of such new forms as have come to light in the course of the work. The collections examined include all the material belonging to the British Museum, as well as many of the more important specimens from the Geological Museum of Cairo. There still remains in Cairo a large collection of bones, which I hope to have an opportunity of working out during the next few weeks.

Mæritherium.

The figure of the skull and mandible of *Mæritherium lyonsi* lately published (Phil. Trans., vol. 196 B, figs. 14–17) was reconstructed from portions of a number of skulls from the Middle Eocene. Since then Mr. H. J. L. Beadnell has found an almost complete skull of a nearly adult animal from the Upper Eocene, and from this the accompanying restoration (Fig. 1) has been made, showing the boundaries of many of the bones, but otherwise differing in no important points from the earlier figure. The mandible has been reconstructed from several Middle Eocene specimens.

The most striking character of the skull as a whole is the great elongation of the cranial as compared to the facial region. The

upper edge of the supra-occipital forms the lambdoidal crest and extends on to the roof of the skull, sending a wedge-shaped process between the hinder ends of the parietals, but there seems to be no trace of a distinct interparietal bone. The parietals are long, extending nearly to the front of the temporal fossa. Their most peculiar character is that they send back on to the occipital surface

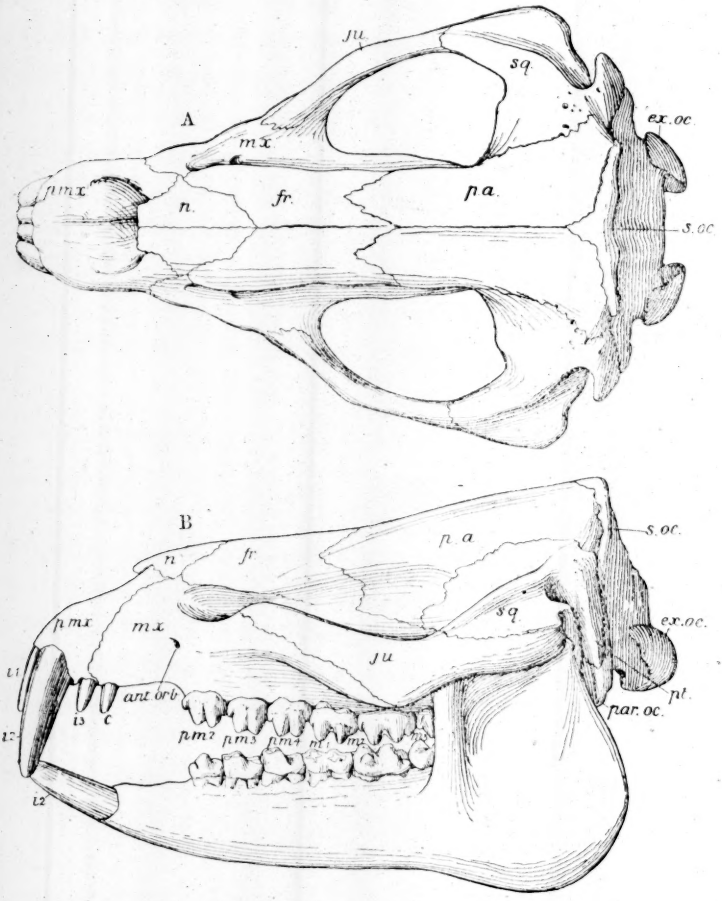


FIG. 1.—Skull of *Mœritherium*.—*A*, from above; *B*, from side. *ant.orb.* antorbital foramen.; *ex.oc.* exoccipital; *fr.* frontal; *ju.* jugal; *mx.* maxilla; *n.* nasal; *pa.* parietal; *par.oc.* paroccipital; *pmx.* premaxilla; *pt.* post-tympanic process of squamosal; *s.oc.* supra-occipital; *sq.* squamosal. *i*1, *i*2, *i*3, incisors; *c*, canine; *pm*2, *pm*3, *pm*4, premolars; *m*1, *m*2, *m*3, molars.

a short process which is wedged in between the supra-occipital and the squamosal. The cranial part of the squamosal, as well as the neighbouring region of the parietals, is considerably swollen

through the development of sinuses which communicate with the outside of the skull by a number of irregularly arranged foramina. The frontals are comparatively short; they are slightly marked by supra-orbital ridges, which run along the upper borders of the orbits; anteriorly they are cut off from the premaxillæ by the union of the maxillæ with the nasals. These latter bones are short, and overhang the narial opening to a very small extent; from behind forwards they form sutures with the frontals, maxillæ, and premaxillæ; in fact, their relations to the surrounding bones are exactly as in the later Proboscidea.

The nasal opening is large and looks forward, not upward as in *Elephas*. It is not at the end of the snout, and the upper surface of the premaxillæ in front of it is deeply grooved, probably indicating the presence of a short proboscis as in the *Tapir*. The orbit is very small, and there is a mere trace of supra-orbital processes.

In the young specimen above referred to, the last molar is still uncut, and from its position it is clear that the rest of the cheek teeth must move considerably forward in order to allow it to come into position.

The occurrence of a species of *Mœritherium*, probably identical with *M. lyonsi*, in the Upper Eocene beds in association with *Palæomastodon* raises the question of whether *Mœritherium* can be ancestral to *Palæomastodon*. If it is not, at least it must be extremely similar and very closely related to the actual ancestor, for it presents all the proboscidean characters in exactly the more generalised condition that one would expect to find. Moreover, it may be pointed out that *Palæomastodon* does not occur in the Middle Eocene beds in which *Mœritherium* is abundant, while in the upper beds *Palæomastodon* is common, and but few *Mœritherium* remains have been found.

From the vertebral column of a large, and at present unnamed, species of *Mœritherium* the number of the vertebræ in the different regions can be ascertained with reasonable certainty. These are: cervical, 7; thoracic, 20; lumbar, 3; sacral, 3; caudal, number unknown, but the tail must have been of moderate length. The axis has a peg-like odontoid, the lower surface of which bears a large facet for articulation with the atlas; the neural spine is high. The centra of the other cervicals are rather short, but longer in proportion to their size than in the later proboscideans.

The scapula is oval in outline; the coracoid process is large, and the glenoid surface for the humerus is continued on to its lower face. The humerus is in some respects more like that of some carnivores than that of an ungulate. Its most remarkable feature is the extreme compression of the shaft from side to side. The ent-epicondyle is very large, and there is no ent-epicondylar foramen. The supinator ridge is well developed. The femur is flattened from before backwards; the great trochanter rises a little above the head, and there is no third trochanter. The distal articular end is relatively small, and the condyles are as in *Elephas*. The feet are at present quite unknown.

Among the specimens collected by me last season is a portion of the right ramus of a mandible containing the three molars: of these m. 3 is in perfect and unworn condition, while m. 2 and m. 1 have lost portions of their outer sides. The character of the teeth here preserved proves the existence in these beds of another small proboscidean related to *Mœritherium*, but differing from it so considerably that when better known it may be necessary to refer it to a new genus; for the present it may be called *Mœritherium trigodon*.

The characters of the teeth are as follows:—

M. 1 was a bilophodont tooth with a small posterior lobe; each transverse crest consisted of two tubercles. Most of the outer half of the tooth is wanting; the inner half consists of a high anterior cusp and a somewhat lower posterior one, separated by a deep valley. The half of the posterior lobe still remaining is nearly flat.

M. 2 also wants a great part of its inner half. It is similar to m. 1, except that the posterior lobe bears a large blunt tubercle, which lies immediately behind the outer tubercle of the posterior crest. These two teeth are very similar to the corresponding ones of *Mœritherium*.

M. 3 is quite unworn; it differs widely from m. 3 of *Mœritherium*. Like the other molars, it consists of two transverse ridges and a talon. The transverse ridges are placed somewhat obliquely; the anterior one consists of a high pointed outer tubercle and an inner one, on the outer face of which a small secondary tubercle is present. In the posterior crest the outer lobe again consists of a pointed tubercle, but the inner half is formed by two subequal tubercles. The talon is composed of a large tubercle in the same antero-posterior line as the outer cusps of the crests, and on its inner side there are several small tubercles; on its outer side the cingulum is well developed. The talon as a whole is thus triangular in outline, its posterior angle being on the outer side of the tooth. In *Mœritherium lyonsi*, on the other hand, the talon is much broader, and consists of an outer and an inner tubercle, which form a third transverse crest, thus converting the tooth into a trilophodont one. This difference in the talons appears to justify the separation of the present form as a distinct species at least, and, as already remarked, further material will probably show that a new genus will have to be established. The enamel of the whole tooth is raised into irregular ridges and small tuberosities.

The dimensions of the specimen are:—

	Length.	Breadth.
m. 1	26 mm.	?
m. 2	32 mm.	?
m. 3	40 mm.	24 mm.

Palæomastodon.

The structure of the skull in this genus is now almost completely known. The most complete specimens yet found are (1) an adult skull wanting part of the occipital and most of the facial regions; (2) the anterior half of a young skull collected by Mr. Beadnell, and

showing the whole of the facial portion in a perfect state of preservation. The figures here given have been constructed from these two specimens, and are sufficient to convey a general idea of the chief characters. It will be seen that in all essential respects this skull is proboscidean, and, in fact, it might almost be described as that of an exceedingly dolichocephalic elephant.

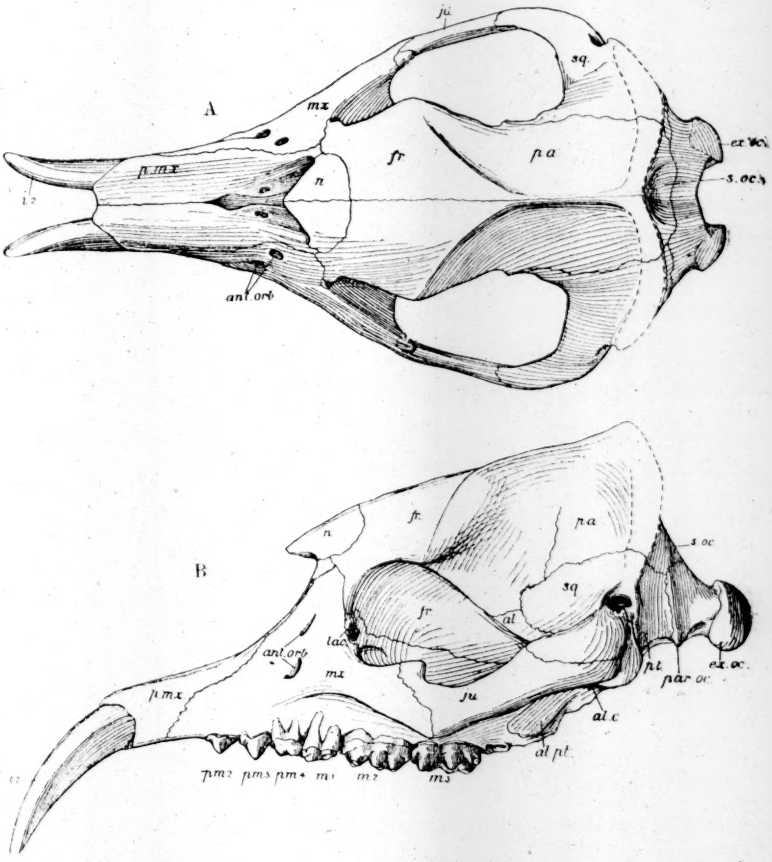


FIG. 2.—Skull of *Palæomastodon*. *A*, from above; *B*, from side. *al.* alisphenoid; *al.pt.* pterygoid wing of alisphenoid; *al.c.* alisphenoid canal; *lac.* lachrymal. The other letters are as in Fig. 1.

The supra-occipital surface slopes somewhat forward, and has a deep median fossa for the attachment of muscles and ligaments, exactly like that found in *Elephas*. The region of the lambdoidal crest, both in the squamosal and the parietal, is considerably swollen by the development of sinuses which communicate with the exterior

and probably with the auditory meatus by several foramina. The swelling of the back of the head has not yet gone far enough to lead to the disappearance of the sagittal crest, which is fairly prominent, and divides anteriorly into the temporal ridges, which run out on to the post-orbital processes of the frontals. The nasals are short, and their relations to the surrounding bones much as in *Elephas*. The nasal opening has already been shifted back a considerable distance behind the anterior end of the snout, but not to the same degree as in the elephants, since it is still in front of the anterior border of the orbits, while in the later forms it has come to lie behind it and at the same time looks more upwards. The premaxillaries have exactly the same relations to the nasal opening and to the neighbouring bones as in *Elephas*, but the form of their anterior portion is quite different, owing to the fact that the tusks are still small, so that the great alveoli and the broad truncated anterior border of these bones, so characteristic of the elephants, are here unnecessary, and they terminate anteriorly almost in a point. The maxilla is greatly elongated. It bears a stout zygomatic process, the base of which is perforated by a large antorbital canal, which opens on the face by two foramina. The lachrymal is exactly as in *Elephas*. The jugal is large, and extends from the orbit back beneath the zygomatic process of the squamosal as far as the glenoid surface for the mandible. The cranial portion of the squamosal is considerably swollen by the presence of air sinuses; it completely surrounds the auditory opening, sending down behind it a post-tympanic (*p.t.*) process. The articular surface for the mandible is very large; it is slightly concave from side to side, and very convex from before backwards; the mandible must have much freer play both from side to side and up and down than in the recent elephants. The alisphenoid is perforated by an alisphenoid canal (*al.c.*), and sends down on to the pterygoid a pterygoid wing (*al.pt.*), the anterior edge of which forms the outer border of a deep groove, which is continued upwards and forwards towards the post-orbital process of the frontal. At the bottom of this groove are the anterior openings of the alisphenoid canal, the *foramen lacerum anterius* and the optic foramen, as in *Elephas*. The tympanic is small, less inflated than in the later type, and does not extend into the mandibular articulation.

There is no distinct condylar foramen; it appears to be confluent with the *foramen lacerum posterius*. The opening of the internal nares is higher than wide; the maxillæ, palatines, and pterygoids which form its side walls are all to some extent thickened by the development of coarsely cellular bone, which is particularly abundant in the portion of the maxilla immediately behind the last molar. The axis of the palate is somewhat bent up with regard to the basi-cranial axis, so that the two make a very obtuse angle with one another: in the elephants this character is carried still further.

The limb bones of *Palæomastodon* are comparatively rare, most of the very large number of bones now collected belonging to *Arsinoitherium*. Such specimens as can be referred with certainty to

Palæomastodon differ in no important points from the corresponding bones of *Elephas*. The calcaneum, however, is less short and stout than in the recent forms, the *tuber calcis* being more elongate; some calcanea from the Miocene of France, probably belonging to *Tetrabelodon angustidens*, approximate most nearly to the Egyptian specimen.

A portion of the right ramus of a mandible shows that there existed in the Upper Eocene beds a species of *Palæomastodon* considerably smaller than *P. beadnelli*, even allowing for a very wide range of individual variation in size in that species. The specimen in question consists of part of the ramus and the coronoid process of an immature mandible, in which m. 3 has not yet been cut, although it is completely developed. M. 3 differs from the same tooth in *P. beadnelli* in having the outer half of the third transverse crest more clearly composed of two distinct tubercles, and in the presence of a short fourth transverse crest separated from the third by a fairly deep valley and composed of three small tubercles. M. 2 is trilophodont, the anterior valley being partly blocked by an accessory tubercle; as usual in this genus, the second molar is considerably larger than the first. This latter, which is already considerably worn, is also trilophodont. Pm. 4 is bilophodont, the anterior crest being considerably the higher. Pm. 3 consists of a single high anterior cusp and a low heel. This species may be called *Palæomastodon minor*; its dimensions compared to those of *P. beadnelli* are shown in the following table, which in the first column gives the length of the teeth in the type of *P. minor*, in the second of those of a small individual (? female) of *P. beadnelli*, and in the third of those of the type of that species:—

	P. minor.	*P. beadnelli* (? female).	*P. beadnelli* (type).
m. 3... ...	47 mm.	... 65 mm.	... 78 mm.
m. 2... ...	45 ,,	... 55 ,,	... 65 ,,
m. 1... ...	32 ,,	... 41 ,,	... 48 ,,
pm. 4 ...	28 ,,	... 39 ,,	... 48 ,,
pm. 3 ...	28 ,,	... 30 ,,	... ?

IV.—Notes on the Cephalopoda belonging to the Strachey Collection from the Himalaya. Part I: Jurassic.

By G. C. Crick, Assoc. R.S.M., F.G.S., of the British Museum (Natural History).

(*Concluded from the February Number.*)

10. Ammonites scriptus (R. Strachey MS.), H. F. Blanford.

H. F. Blanford, in J. W. Salter & H. F. Blanford: Palæont. Niti, 1865, p. 81, pl. xvi, figs. 2*a–c*.)

According to Professor Blanford the only example of this species in the Strachey Collection was the fragment which he figured. This is now in the British Museum collection [No. C. 5045]; it was transferred from the Museum of Practical Geology, labelled with one of that Museum's labels "Oolitic: Niti Pass. Ammonites scriptus (Stra.). Coll. by Col. Strachey." The figures, which are all reversed,

are not good. The portion of the fossil that is figured is entirely septate; the anterior part of the specimen that formed the base of the body-chamber is not included in the figure, nor does the figure show the shorter intermediate ribs which extend over the outer half of the lateral area of the whorl.

Blanford (p. 106) regarded this species as a synonym of Oppel's *A. Stanleyi*,[1] a species which he considered to have priority of publication.

11. Ammonites jubar (R. Strachey MS.), H. F. Blanford.

(H. F. Blanford, in J. W. Salter & H. F. Blanford: Palæont. Niti, 1865, p. 82, pl. xx, figs. 2*a–c*: pl. xxi, figs. 1*a–c*.)

The British Museum collection contains three examples of this species, numbered C. 5043, C. 5044, and C. 5030 respectively.

The specimen numbered C. 5043 is the original of plate xx, figs. 2*a*, *b*. The posterior half of the outer whorl, that is, the portion to the right of the break indicated in fig. 2*a*, is now missing, but the cement still adhering to the fossil indicates its former presence; it was possibly from the now missing part that the suture-line depicted in fig. 2*c* was drawn. About one-third of the rest of the outer whorl is septate, whilst the remainder formed part of the body-chamber. As part of the Strachey Collection this specimen was transferred from the Museum of Practical Geology, labelled with one of that Museum's labels "Oolitic: Niti Pass. Ammonites jubar. Coll. by Col. Strachey."

The example No. C. 5044 is the natural mould, of which a gutta-percha impression (also preserved) is figured in pl. xxi, fig. 1*a*. Belonging to the same collection it was also transferred from the same Museum. It is labelled with one of that Museum's labels "Oolitic: Niti Pass. Ammonites jubar (Stra.). Coll. by Col. Strachey." To it is fastened a small white label on which is written in ink "Ammonites jubar, R. S. Budarinathix"; but the word 'jubar' has been crossed out in ink.

The specimen No. 5030 also belonged to the Strachey Collection and was transferred from the Museum of Practical Geology, but the precise locality of the specimen is not recorded. It is the original of plate xxi, fig. 1*b*, and probably also furnished the restored outline given in fig. 1*c*.

I have not been able to recognize the original of the suture-line which is figured on pl. xx and numbered 2*d*; this appears not to be referred to in the text.

On p. 106 Professor Blanford placed this species as a synonym of Oppel's *A. Sabineanus*,[2] a name which he considered to have priority of publication.

[1] A. Oppel, "Ueber ostindische Fossilreste aus den secundären Ablagerungen von Spiti und Gnari-Khorsum in Tibet": Pal. Mittheil., iv (1863), p. 282, pl. lxxix, figs. 1*a–c*.

[2] A. Oppel, "Ueber ostindische Fossilreste aus den secundären Ablagerungen von Spiti und Gnari-Khorsum in Tibet": Pal. Mittheil., iv (1863), p. 288, pl. lxxxii, figs. 1*a–c*; 2*a*, *b*.

AMMONITES JUBAR, var. A. MULTIRADIATUS (R. Strachey MS.), H. F. Blanford.

(H. F. Blanford, in J. W. Salter & H. F. Blanford: Palæont. Niti, 1865, p. 82.)

Professor Blanford states that "this differs from the normal form in the greater number of its ribs (55), which are consequently more close set and filiform. The variation probably occurs only in young shells." In the Strachey Collection transferred from the Museum of Practical Geology, and labelled with that Museum's label "Oolitic: Niti Pass. Ammonites triplicatus (Sow.). Coll. by Col. Strachey," there is a fairly complete specimen [C. 7366], 46·5 mm. in diameter, which agrees very well with Blanford's description of this variety. It has about 52 ribs in the outer whorl, and although labelled '*Ammonites triplicatus*' it certainly does not agree with that species. This is the only specimen in the collection that corresponds to Blanford's description, and it is therefore most probably the variety referred to.

12. AMMONITES OCTAGONUS (R. Strachey MS.), H. F. Blanford.

(H. F. Blanford, in J. W. Salter & H. F. Blanford: Palæont. Niti, 1865, p. 83, pl. xii, figs. 2*a*, *b*.)

According to Professor Blanford's description, "the only specimen of this Ammonite in Colonel Strachey's Collection is a fragment, but of larger dimensions and in better preservation than that previously described from Spiti." This fragment is now in the British Museum collection [C. 5032], having been transferred from the Museum of Practical Geology, accompanied by one of that Museum's labels on which was written in ink simply the name "Am. octagonus, Strachey," without any record of either horizon or locality, and without any indication that it was the figured specimen. But of this fact there cannot be the slightest doubt; fig. 2*a* representing a lateral aspect of the fragment (reversed), and fig. 2*b* a much restored transverse section of the whorl.

Later in the same work (p. 106) Blanford united Strachey's *A. Hookeri* with the present species under the name *A. octagonus*, this species having been described some two years previously.[1]

13. AMMONITES HOOKERI (R. Strachey MS.), H. F. Blanford.

(H. F. Blanford, in J. W. Salter & H. F. Blanford: Palæont. Niti, 1865, p. 83, pl. xvii, figs. 1*a*–*d*.)

The figures illustrating Professor Blanford's description (pl. xvii, figs. 1*a*–*d*) have been drawn (reversed) from two specimens, which are now in the British Museum collection [C. 5048 and C. 5049]. Fig. 1*a* has been drawn from the example bearing the register number C. 5048, and the other figures have been taken from the specimen No. C. 5049. Both specimens were transferred, in 1880, from the Museum of Practical Geology, the smaller one [C. 5048] labelled "Oolitic: Niti Pass. Ammonites Hookeri (Stra.). Coll. by Col. Strachey." There is now no Jermyn Street Museum label with the larger specimen, but there is no doubt whatever as to its

[1] Journ. As. Soc. Bengal, vol. xxxii, No. 2 (1863), p. 128, pl. i, figs. 5*a*–*c*.

being the other specimen figured by Blanford. Each fossil has been numbered in ink "1830"; this is Strachey's original number, and indicates that the two examples came from the same locality, viz. the Niti Pass, this being the only locality mentioned in the list of fossils given on p. 102 of Salter & Blanford's work.

The posterior third of the outer whorl of the smaller example (fig. 1*a*) appears to be septate, whilst the rest seems to have formed part of the body-chamber. The larger example (figs. 1*b*–*d*) is entirely septate; it is part of a whorl which must have been at least 70 mm. in diameter. The suture-line has been painted in, and evidently formed the original of fig. 1*d*. The transverse section depicted in fig. 1*c* has been much restored.

On p. 106 Professor Blanford places this species as a synonym of Strachey's *A. octagonus*, to which species he also refers Oppel's *A. Sommerringi*.[1]

14. Ammonites medea (R. Strachey MS.), H. F. Blanford.

(H. F. Blanford, in J. W. Salter & H. F. Blanford: Palæont. Niti, 1865, p. 84, pl. xix, figs. 5*a*, *b*.)

Professor Blanford says: "The only specimen of this MSS. species of Colonel Strachey in his collection is the fragment figured, from which it is difficult to pronounce upon its affinities. It may be either, as surmised by Colonel Strachey, a species allied to *A. Jason*, Zieten, or a portion of a large specimen of the tuberculate form of *A. Wallichii*, Gray."

This specimen is now in the British Museum collection [C. 5047], having been transferred from the Museum of Practical Geology, in 1880, labelled with one of that Museum's labels 'Oolitic: Niti Pass. Ammonites medea. Coll. by Col. Strachey." It bears the number "18" in white paint. It is not well represented in the figures: the spines are not nearly so much elevated as shown in fig. 5*b*; and further, they are symmetrically disposed in regard to the median line of the flattened (i.e. the peripheral) area, and not irregularly placed as might be supposed from fig. 5*a*; the two rows of spines are 13 mm. apart, the spines being exactly opposite each other and arranged in each row at intervals of about 5 mm. The fragment shows no traces of septa, and appears to have formed part of the body-chamber.

15. Ammonites Wallichii, J. E. Gray.

(H. F. Blanford, in J. W. Salter & H. F. Blanford: Palæont. Niti, 1865, p. 84, pl. xv, figs. 1*a*–*e*; pl. xix, figs. 1*a*–*e*, 2*a*–*e*.)

Besides the specimen [C. 5041] which was originally figured by Gray (Illust. Indian Zoology, 1830–32, pl. c, fig. 3) and refigured, as elsewhere shown,[2] by Blanford (op. cit., pl. xv, fig. 1), and the example [31,106] referred to by Blanford (p. 84, footnote) as measuring "not less than six inches in diameter," the British

[1] A. Oppel, "Ueber ostindische Fossilreste aus den secundären Ablagerungen von Spiti und Gnari-Khorsum in Tibet": Pal. Mittheil., iv (1863), p. 280, pl. lxxx, figs. 1*a*, *b*.

[2] G. C. Crick: Proc. Malac. Soc., vol. v, pt. 4 (April, 1903), p. 287.

Museum contains six specimens which were transferred from the Museum of Practical Geology. Five of these [Nos. C. 7675*a–e*] belonged to the Strachey Collection, and were labelled with one of that Museum's labels "Oolitic: Niti Pass. Ammonites Wallichii. Coll. by Col. Strachey," but on one [No. C. 7675*d*] there has been written in ink the locality "nr. Chirchun." The sixth specimen [No. C. 7684] was labelled "A. Wallichii, var. γ. Spiti shales," but though there is no record as to its having formed part of the Strachey Collection, there is good reason to believe that it did, since it is numbered "11" in white paint exactly like the specimen No. 7675*d*.[1]

Professor Blanford's figures of this species represent several individuals. His pl. xv, figs. 1*a*, *b* represent Gray's type-specimen, to which also belongs the suture-line lettered in the published copies of the plate 2*b*,[2] evidently a mistake for 1*c*.

The specimen in the British Museum numbered C. 7675*a* is the original of pl. xix, figs. 1*a* and *b*; the figures, besides being reversed, have been very much restored, the first third of the outer whorl being very imperfect in the original. As it does not exhibit the suture-line, fig. 1*c* must have been drawn from another specimen; this we have not yet been able to identify in the collection.

The example in the same collection numbered C. 7675*b* is the original of pl. xix, figs. 2*a*, *b*; both figures have been reversed and restored; part of the matrix has been omitted, the first part of the outer whorl is now absent, and the peripheral terminations of the ribs are represented much too strong. The suture-line has been painted in and was evidently copied in fig. 2*c*, but this specimen does not exhibit the portion of the suture-line on the inner area of the whorl at all clearly; this portion of the line, however, is well shown and has been marked on the example No. C. 7684. It is concluded, therefore, that figs. 2*a*, *b* were drawn from the example No. C. 7675*b*, and that fig. 2*c* was taken chiefly from the same specimen, but partly also from the fossil No. C. 7684. Although there is no record that this specimen originally belonged to the Strachey Collection, there is, as we have already stated, good evidence for believing that such was the case.

Blanford (p. 106) regards Oppel's *A. Mörikeanus*[3] as a synonym of this species.

16. Ammonites robustus (R. Strachey MS.), H. F. Blanford.

(H. F. Blanford, in J. W. Salter & H. F. Blanford: Palæont. Niti, 1865, p. 85, pl. xvi, figs. 1*a–c*.)

Professor Blanford figured two specimens which he referred to this species; they are both in the British Museum collection

[1] Other specimens are similarly numbered. Thus, *A. medea* [C. 5047], pl. xix, figs. 5*a*, *b*, is marked "18"; *A. Wallichii* [C. 7675*a*], pl. xix, figs. 1*a*, *b*, is marked "12"; and *A. Wallichii* [C. 5041], pl. xv, figs. 1*a–c* (which is also one of Gray's type-specimens), is marked "10."

[2] G. C. Crick: op. cit., p. 288.

[3] A. Oppel, "Ueber ostindische Fossilreste aus den secundären Ablagerungen von Spiti und Gnari-Khorsum in Tibet": Pal. Mittheil., iv (1863), p. 281, pl. lxxx, figs. 2*a*, *b*.

[Nos. C. 5050 and C. 5046]. They were regarded as of Jurassic age, but they are much more probably Triassic fossils, and have been elsewhere described as such by the present writer.[1]

17. Ammonites Griffithii (R. Strachey MS.), H. F. Blanford.

(H. F. Blanford, in J. W. Salter & H. F. Blanford: Palæont. Niti, 1865, p. 86, pl. xx, figs. 1*a–c*.)

This species was founded upon a single specimen, which, as described by Professor Blanford, "is an imperfect shell, and bears the remains of three-fourths of another whorl. The figure is three-fourths of the real size of the specimen." This fossil is now in the British Museum collection [No. C. 5038]; it was transferred from the Museum of Practical Geology, labelled with one of that Museum's labels "Oolitic: Niti Pass. Ammonites Griffithi. Coll. by Col. Strachey." The specimen is entirely septate; the suture-line (fig. 1*c*) seems to have been taken from quite close to the anterior end of the fossil, where it has been traced in white paint.

According to Blanford (p. 106) this species is a synonym of *A. Theodorii*, Oppel,[2] a name which claims priority of publication.

18. Ammonites strigilis, H. F. Blanford.

(H. F. Blanford, in J. W. Salter & H. F. Blanford: Palæont. Niti, 1865, p. 87.)

Professor Blanford refers to an example in the Strachey Collection in the following terms:—"A single specimen (cut in half and polished) of this Ammonite (without specified locality) only differs from the original Spiti specimen in its somewhat larger size. Diameter of shell, $2\frac{1}{2}$ in. Diameter of outer whorl, $1\frac{1}{4}$ in."

I have not been able to identify an example of this species in the Strachey Collection in the British Museum, but the National collection contains the specimen [39.797], to which, when describing this species in 1863 (Journ. Asiatic Soc. Bengal, vol. xxxii, 1863, p. 126) from the half of a cut specimen, Blanford refers as possibly the fellow of the type-specimen. It is labelled "Himalaya"; but its history and exact locality are unrecorded.

19. Ammonites acucinctus (R. Strachey MS.), H. F. Blanford.

(H. F. Blanford, in J. W. Salter & H. F. Blanford: Palæont. Niti, 1865, p. 87, pl. xviii, figs. 1*a–e*; pl. xix, figs. 4*a–d*; var. α (*A. mundus*, R. Strachey MS.), pl. xviii, figs. 2*a*, *b*.)

Of this species the British Museum collection contains five more or less incomplete examples [Nos. C. 7360*a–e*] that belonged to the Strachey Collection and were transferred from the Museum of Practical Geology, labelled with one of that Museum's labels "Oolitic: Niti Pass. Ammonites acucinctus (Stra.). Coll. by Col. Strachey"; also two other examples [Nos. C. 7361*a*, *b*], with a plain

[1] G. C. Crick: Proc. Malac. Soc., vol. v, No. 4 (April, 1903), pp. 290 et seq.

[2] A. Oppel, "Ueber ostindische Fossilreste aus den secundären Ablagerungen von Spiti und Gnari-Khorsum in Tibet": Pal. Mittheil., iv (1863), p. 280, pl. lxxviii, figs. 3*a–e* (and pl. lxxxiii, figs. 2*a*, *b*).

label bearing in pencil the words "A. acucinctus Spiti shal[es]," that were also transferred from the same Museum, but there is no record whether they belonged to the Strachey Collection or not. Amongst the specimens that undoubtedly belonged to the Strachey Collection there is no single specimen from which all the figures 1*a–c* on pl. xviii could have been drawn. Allowance must, however, be made for the illustrations, for in his description of the species Blanford says "The figure of this species given in plate 18 is, in some respects, erroneous. The ribs in fig. 1*a* should conform to the shape of the mouth, instead of being but slightly flexuous, and the periphery should be ornamented with minute sharp teeth, instead of crenulations."

The specimen registered C. 7360*a* appears to be the original of fig. 1*b*, the figure being reversed; its size agrees also with fig. 1*a*, but its sculpture is much less distinct, and its suture-line is not visible. The sculpture of the species is best shown upon the fragment registered C. 7360*d*, and numbered in ink "1840," which at one time appears to have another piece attached to it; this fragment also exhibits traces of the suture-line, but these are quite insufficient to have furnished the drawing of the suture-line given by Blanford (fig. 1*c*). The form of the peristome indicated in fig. 1*a* appears to have been drawn from the example No. C. 7360*b*, which is, however, only about one-half of the size of the figure. The sculpture could not possibly have been taken from this specimen, the surface of which is nearly smooth; nor the suture-line, for although feebly indicated it is not sufficiently preserved to have formed the original of fig. 1*c*.

Of the two other examples of this species [C. 7361*a*, *b*] which were also transferred from the Museum of Practical Geology, and which most probably belonged to the Strachey Collection, although direct evidence of this is wanting, one [C. 7361*b*] exhibits the suture-line very clearly, and there is every probability, not only that these specimens originally formed part of the Strachey Collection, but that the specimen C. 7361*b* furnished the original of the suture-line represented in fig. 1*c*.[1]

With regard to the figures of this species in the "Palæontology of Niti," I conclude, therefore, that fig. 1*b* has been drawn from the specimen No. C. 7360*a*; that fig. 1*a* has been drawn in part from the example No. C. 7360*b*, and possibly in part also from the specimens C. 7360*a* and C. 7360*d*; and that fig. 1*c* has been taken from the specimen C. 7361*b*. I have not been able to recognize in the collection the original of figs. 4*a–d* on pl. xix.

The species was originally described by H. F. Blanford in 1863 (Journ. Asiatic Society of Bengal, vol. xxxii, 1863, p. 126, pl. i, figs. 3, 3*a*). He considered (p. 106) *A. Lymani*, A. Oppel (Pal. Mittheil., iv (1863), p. 272, pl. lxxvi, figs. 3*a–c*), to be a synonym.

[1] F. Stoliczka (Mem. Geol. Surv. India, vol. v, pt. 1, 1865) says (p. 93), "Fig. 1*c* in Strachey's Pal. pl. 18 gives no good idea of the true form of the lobes and saddles. The figure was evidently taken from a specimen with a very much eroded surface."

Var. *a* (=*Ammonites mundus*, R. Strachey MS.).

In his description (p. 88) of this variety Professor Blanford states that "the two fragments in the [Strachey] collection are those of larger shells than any of the normal form." Amongst the examples forming part of the Strachey Collection which was transferred from the Museum of Practical Geology, this variety is represented by a single imperfect specimen [No. C. 5035] enclosed in a portion of a nodule in association with a part of the phragmocone of a Belemnite (probably the form which Blanford referred to Miller's *B. sulcatus*), and a fragment of a thick-whorled biplicated Ammonite (like *A. torquatus*); it is labelled with a Jermyn Street Museum label "Oolitic: Niti Pass. Ammonites acucinctus (Stra.), Ammonites biplex (Sow.), Belemnites sulcatus (Mill.)." The specimen comprises only about the last third of the outer whorl; this seems to have formed part of the body-chamber, as no septa are visible; of the rest of this whorl and of the earlier whorls there is an impression on the nodule that shows clearly the character of the ornaments of the test. This fossil is most probably the figured example, the figure having been reversed and very much restored. The direction of the striæ has been indicated on the fossil in pencil, probably to assist the artist. The dimensions of the specimen appear to have been:—diameter of shell, about 53 mm.; radius of shell, 31 mm.; height of outer whorl, 24·5 mm.; thickness of outer whorl, 14 mm.; width of umbilicus, 12 mm.

The following are figured among the Jurassic Cephalopoda, but are not referred to in the text of the work:—

20. Ammonites Batteni (R. Strachey MS.), H. F. Blanford.

(H. F. Blanford, in J. W. Salter & H. F. Blanford: Palæont. Niti, 1865, pl. xi. figs. 2*a*–*c*.)

These figures are placed among the illustrations of Jurassic Ammonites, and are named at the foot of the plate "*Am. Batteni*," but the species appears not to be referred to in the text. The original of the figures is in the British Museum collection [No. C. 4867]; it was transferred from the Museum of Practical Geology labelled with one of that Museum's labels "Oolitic: Niti Pass. Ammonites Batteni. Coll. by Col. Strachey"; but I think there can be no doubt about its being, as has already been pointed out, a Triassic species referable to the genus *Gymnites*.[1] It will therefore be more fully dealt with among the Triassic species belonging to the Strachey Collection.

21. Ammonites, sp.

(H. F. Blanford, in J. W. Salter & H. F. Blanford: Palæont. Niti, 1865, pl. xix. figs. 3*a*–*c*.)

The original of these figures—fig. 3*a* representing the specimen of the natural size—is in the British Museum collection [No. C. 7677]. It is not referred to in the text. The specimen was transferred

[1] See C. Diener: Mem. Geol. Surv. India, Pal. Indica, ser. xv, vol. ii, pt. 2 (1895), p. 53 et seq.

ALPHABETICAL LIST OF THE STRACHEY COLLECTION OF JURASSIC CEPHALOPODA figured and described by Professor H. F. Blanford, in Salter & Blanford's Palæont. Niti, 1865.

No. in Paper.		Page.	Plate.	Figure.	Location and registered number of specimen.
19	*Ammonites acuecinctus* (R. Strachey MS.), H. F. Blanford	87	xviii	1*a*	B.M. { C. 7360*b*, ? C. 7360*a*, ? C. 7360*d*
		87	xviii	1*b*	B.M., C. 7360*a*
		87	xviii	1*c*	B.M., C. 7361*b*
	,, ,, ,, ,,	87	xix	4*a–d*	?
	,, ,, var. α (*A. mundus*, R. Strachey MS.)	88	xviii	2*a, b*	B.M., C. 5035
2	,, *alatus* (R. Strachey MS.), H. F. Blanford ...	76	xviii	3*a*	B.M. { C. 7364*a*, C. 7365
	,, ,, ,, ,,	76	xviii	3*b*	?
20	,, *Batteni*, H. F. Blanford		xi	2*a–c*[1]	B.M., C. 4867
7	,, *biplex*, J. Sowerby	79	xi	1*a*	B.M., C. 5033
	,, ,, ,, ...	79	xi	1*b, c*	?
	,, ,, ,, ...	79	xii	1*a–c*	?
17	,, *Griffithii* (R. Strachey MS.), H. F. Blanford	86	xx	1*a–c*	B.M., C. 5038
6	,, *guttatus* ,, ,,	79	xiii	2	B.M., C. 7358
13	,, *Hookeri* ,, ,,	83	xvii	1*a*	B.M., C. 5048
		83	xvii	1*b–d*	B.M., C. 5049
11	,, *jubar* ,, ,,	82	xx	2*a, b*	B.M., C. 5043
	,, ,, ,, ,,	82	xx	2*c*	B.M., ? C. 5043
	,, ,, ,, ,,	82	xx	2*d*	?
	,, ,, ,, ,,	82	xxi	1*a*	B.M., C. 5044
	,, ,, ,, ,,	82	xxi	1*b, c*	B.M., C. 5030
	,, ,, ,, var. α, *multiradiatus* (R. Strachey MS.), H. F. Blanford	82		no fig.	? B.M., C. 7366
14	,, *medea* ,, ,,	84	xix	5*a, b*	B.M., C. 5047
	,, *multiradiatus* ,, v. *A. jubar*, var. α				
	,, *mundus* ,, v. *A. acuecinctus*, var. α				
3	,, *Nepalensis*, J. E. Gray	77	xiv	1*a, b*	G.S.M., R. 10116
12	,, *octagonus* (R. Strachey MS.), H. F. Blanford	83	xii	2*a, b*	B.M., C. 5032
16	,, *robustus* ,, ,,	85	xvi	1*a*, *c*[1]	B.M., C. 5050
	,, ,, ,, ,,	85	xvi	1*b*[1]	B.M., C. 5046
10	,, *scriptus* ,, ,,	81	xvi	2*a–c*	B.M., C. 5045
18	,, *strigilis*, H. F. Blanford	87		no fig.	?
4	,, *tenuistriatus*, J. E. Gray	78	[xiv	2?]	B.M., C. 5039
	,, ,, ,, ...	78	xv	2*a*	B.M., C. 5036
	,, ,, ,, ...	78	xv	2*b, c*	B.M., C. 5051
[	,, ,, ,, ...	78	xv	2*d*[2]]	
9	,, *torquatus*, J. de C. Sowerby	80		no fig.	
8	,, *triplicatus*, J. Sowerby	80	xiii	1*a, b*	B.M., C. 5042
	,, ,, ,, ...	80	xiii	1*c*	B.M., C. 5031
5	,, *umbo* (R. Strachey MS.), H. F. Blanford ...	78	xvii	2*a–d*	B.M., C. 5040
15	,, *Wallichii*, J. E. Gray	84	xv	1*a*, *b*, 2*d*[3]	B.M., C. 5041
	,, ,, ,, ...	84	xix	1*a, b*	B.M., C. 7675*a*
		84	xix	1*c*	?
	,, ,, ,, ...	84	xix	2*a, b*	B.M., C. 7675*b*
		84	xix	2*c*	B.M. { C. 7675*b*, C. 7684
21	,, sp.		xix	3*a–c*	B.M., C. 7677
1	*Belemnites sulcatus*, J. S. Miller	76	x	1	B.M., C. 2566
	,, ,, ,, ...	76	x	2	B.M., C. 2567
	,, ,, ,, ...	76	x	3	B.M., C. 2568
	,, ,, ,, ...	76	x	4	B.M., C. 2569
	,, ,, ,, ...	76	x	5	B.M., C. 2570
	,, ,, ,, ...	76	x	6	B.M., C. 2571
	,, ,, ,, ...	76	x	7	G.S.M., R. 10252
	,, ,, ,, ...	76	x	8	B.M., C. 2572

[1] Triassic specimens.
[2] This figure has been wrongly lettered; it belongs to *A. Wallichii* and should be 1*c*.
[3] This figure should have been letter 1*c*, since it belongs to *A. Wallichii* and not to *A. tenuistriatus*.

from the Museum of Practical Geology apparently with the rest of the Strachey Collection, although there is now no information with the fossil. There is, however, a loose Jermyn Street Museum label, without any specimen, to the following effect:—"Oolitic: Niti Pass. Ammonites orbiculatus. Coll. by Col. Strachey." I have not met with this specific name in any descriptions of Himalayan fossils, but the form of the present specimen would most likely suggest such a specific name, and I therefore think there is every probability of this label having belonged originally to this example, although direct evidence of the fact is wanting. If, however, the name *A. orbiculatus* has been used in connection with any Jurassic Cephalopod from the Himalaya, it probably refers to this specimen.

V.—The Zone of *Hoplites interruptus* (Bruguière) at Black Ven, Charmouth.

By W. D. Lang, B.A., F.Z.S., British Museum (Nat. Hist.).

LYING unconformably upon the well-known Liassic beds of Black Ven, the cliff which overhangs the sea-shore between Lyme Regis and Charmouth, occur beds of Cretaceous age, representing the Gault and Upper Greensand of other localities. The lower beds consist of loams, dark and almost black where the clay predominates over the sand, and lighter where the sand is present in larger quantities. Above these loams are yellow sands containing indurated nodules called 'Cowstones,' which, with the 'Foxmould' sands above them, have been considered to represent the zone of *Schlœnbachia rostrata* (Sowerby).[1] The dark loams below them represent, therefore, the zone of *Hoplites interruptus* (Bruguière).

Of this zone some account has been given in the Survey Memoir;[2] but as the section given, measured in 1895, agrees only generally with those measured by the author in 1901 and 1902, differing conspicuously in the absence of the hard shales to be described later; and as the two last-mentioned sections, though separated for some distance, are obviously continuous, it may not be out of place to describe the sections that are exposed at the time of writing. For the cliff frequently falls, causing the covering up of old sections and the exposure of new. And though, until it was measured in detail, the western section was thought to be that described in the Survey Memoir and measured in 1895, the author now thinks that a new section is exposed, showing three bands of hard shaly loam unrecorded before.

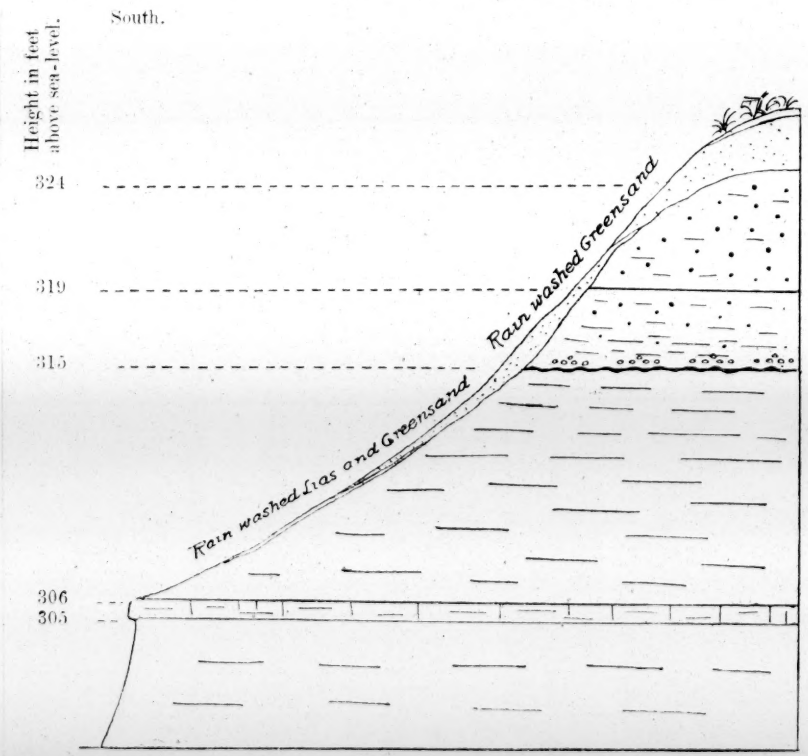
Concerning the eastern section, which shows the junction with the Lias, it may be that described as having been found by Mr. C. Reid in 1875.[3] At present, however, it is not at all obvious, being covered by some thickness of 'rainwash,' so that to expose the junction some amount of digging has to be performed.

[1] A. J. Jukes-Browne: "The Gault and Upper Greensand of England," 1900, p. 183.

[2] Jukes-Browne: loc. cit., pp. 187–189.

[3] Jukes-Browne: loc. cit., p. 189.

FIG. 1.—SECTION SHOWING THE JUNCTION BETWEEN THE LIAS AND THE CRETACEOUS.



	Surface soil.			
	Fallen Greensand.			
324	Dark-green, glauconitic, loamy sand, with occasional patches of yellow sand. No fossils.	5 ft.	Zone of *Hoplites interruptus.*	SELBORNIAN. 2.
319	Black glauconitic loam, sandier at the top, and more argillaceous lower, with an impersistent pebble-bed at the base.	4 ft.		1.
315	'Green Ammonite Beds.'		Zone of *Liparoceras capricornus.*	LIAS.
	Very sticky blue clay, containing Lias Ammonites.	10 ft.		
306	'Belemnite Stone.'	1 ft.	Zones of *Amaltheus davæi*, *Uptonia jamesoni*, *Deroceras armatum.*	
305	'Belemnite Marls.'			

The reason why this zone is so rarely exposed in section is that the beds above it are sandy and pervious to rain, and those belonging to it are also to a large extent pervious. On the other hand, the Lias clay upon which it rests is extremely impervious. Consequently the line of junction between this zone and the underlying Lias is marked by a succession of springs, forming boggy ground covered with overgrowth. Sections are therefore of rare occurrence.

This tract of boggy ground lies on Black Ven at a height of over 300 feet above sea-level, and from 50 to 100 feet below the new Lyme road. This it crosses on its descent, eastwards of Charmouth cutting, and is not very noticeable as it turns northwards over the old Lyme road. Thence it sweeps round the hillside above and parallel with the Axminster road, and becomes very obvious in the fields below "Fernhill," where the springs which supply the village lie. Further, this boggy tract can be traced across the Axminster road, in the neighbourhood of Hogchester farm, and so up the valley; but no inland sections have been found.

On the eastern side of the Char valley, on Stonebarrow cliff and round Stonebarrow hill, this tract of land is not so obvious, doubtless because the line between the pervious and the impervious is not so clearly defined. For the Cretaceous beds on Stonebarrow cliff rest on the lowermost beds of the zone of *Amaltheus margaritatus*, Mont., known as the "Three Tiers,"[1] which are loamy; whereas on Black Ven they overlie the lower beds of the zone of *Liparoceras capricornus* (Schlotheim),[2] which consist of impervious clays.

The more eastern section on Black Ven shows the junction between the Cretaceous and the Lias. It lies on the cliff face, at a height of about 315 feet, directly beneath the Charmouth end of the Charmouth cutting, where the descent to the village begins. It is covered with fallen Greensand, and was found as follows:—

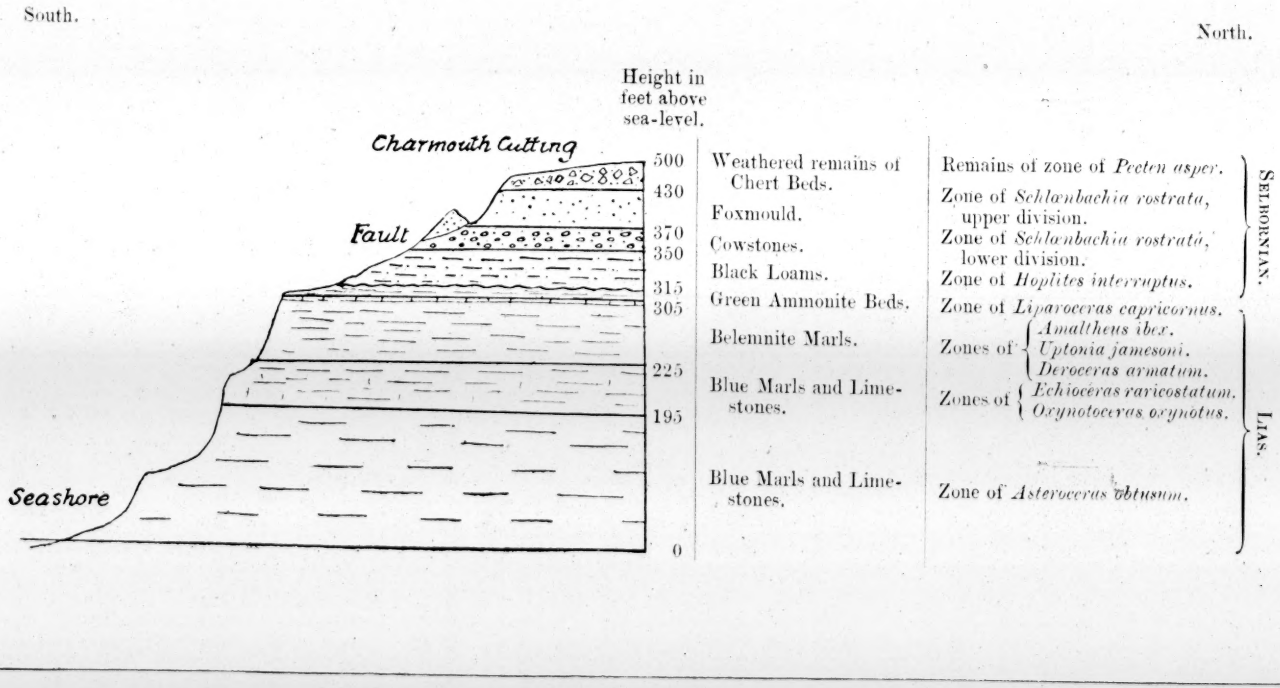
The edge of a steep precipice just below the section is formed by the outcrop of a limestone a foot thick, the 'Belemnite Stone.' Above this the cliff face slopes backwards at a moderate angle, and on this slope Lias fossils and worm-tubes from the Cretaceous beds are found mixed. This slope was followed upwards until the highest Lias fossil was found. A foot or so above this a hole was dug, and after clearing away perhaps a foot of loose fallen sand, the junction was hit. The section was measured in December, 1902, and the hole dug was still visible in December, 1903, and easy to find.

The details of the section are given in Fig. 1 (p. 125).

Bed 1. The pebbles at the base of the black loam do not form a continuous bed, but occur in pockets, which may be six inches thick at the widest part. Between these pockets are spaces where no pebbles occur, but the dark green-black loam is directly superimposed upon the blue clay of the Lias, forming a contrast, and contains itself so much clay that it is coherent enough to allow quite small specimens to be dug out, showing the junction as a sharp wavy line (see Fig. 3, p. 128).

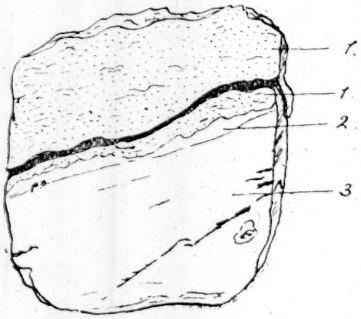
[1] H. B. Woodward: "The Lias of England and Wales," 1893, pp. 195, 196.
[2] H. B. Woodward: loc. cit., p. 68.

FIG. 2.—GENERAL SECTION OF BLACK VEN.



In these specimens there is a very thin layer of clay varying from about ¼ inch to an almost imperceptible thickness, of paler colour than the clay below. The upper boundary of this layer is the jagged, wavy, but sharply defined line already mentioned, and the lower boundary a much less clearly defined though comparatively straight line. This pale layer is described from dried specimens, and it was not seen whether it was noticeable when they were freshly cut.

Fig. 3.—Specimen showing the Junction between the Selbornian and Lias on Black Ven, natural size.



1. Selbornian Loam.
2. Pale band at the top of Lias Clay.
3. Lias Clay.

The pebble bed is not easy to see, as the pebbles are very inconspicuous, but its presence is easily detected by the grating of the pebbles against the trowel when the bed is dug into.

The pebbles vary in size from that of a pigeon's egg to that of coarse sand. They are mostly subangular, but some are well rounded, and are nearly all of silica in various forms. Vein quartz is the chief of these, forming the largest pebbles. Others are of brown chert with a very smooth pale-green altered surface. A few were of white limestone and of black grit. A few fragments of Belemnite were also found. The constituents of a washed sample are given in the Survey Memoir.[1]

The matrix in which the pebbles lie is a loam of dark greenish colour, the darkness being due to the presence of blue clay, and the green to that of a small quantity of glauconite. The loam also contains a little mica. The bed becomes sandier towards the top, gradually passing into the next bed.

No fossils were found in this bed, nor in bed 2.

Bed 2. This is like bed 1, but sandier, and consequently lighter in colour. Yellow patches of comparatively pure sand occur in it.

A few feet up this bed is overlain by a mass of yellow sand fallen from the higher beds, upon which rests the soil of the cliff slope above. This slope is very slight, and is marked by a tract of overgrown land from 50 to 100 yards wide, backed by a cliff of yellow

[1] Jukes-Browne: loc. cit., p. 189.

sand of the beds known as 'Foxmould' in the zone of *Schlœnbachia rostrata*. This cliff immediately underlies the road, and is the seaward face of a large mass of land which has slipped bodily down the cliff, forming the fault shown in the diagrammatic section of Black Ven (see Fig. 2, p. 127).

About 250 yards west of that just described is a section showing the upper part of the zone of *Hoplites interruptus* and the lower part of the zone of *Schlœnbachia rostrata*. The cliff arises from the platform of boggy ground mentioned early in this paper, and is about 70 feet high, the top being formed of 'Foxmould' just above the highest layer of 'Cowstones.' The details of the beds in the first-mentioned zone are shown in the following figure (Fig. 4, p. 130).

Bed 2. This bed agrees lithologically with that numbered 2 in the eastern section; and being, as far as can be determined, at the same height, is obviously identical with it. Thus the two sections are continuous, and the whole thickness of the zone is exposed. The total thickness of this bed is probably about ten feet, and so the sections overlap for three feet, two feet being hidden below the western section, and three having been removed above the eastern.

Bed 3. This is the most interesting bed in the zone, for it abounds in fossils in its lowest part. The nearest locality whence abundance of Gault fossils has been obtained is distant about thirty miles at Okeford Fitzpaine, where the lower beds have been recognised[1] as belonging to the zone of *Acanthoceras mammillatum* (Schlotheim), which is there five feet in thickness. So it is possible that beds 1 and 2 may represent this zone on Black Ven, but the absence of fossils makes this point impossible to decide.

Of the fossils from bed 3 a list is given in the Survey Memoir.[2] But in addition the British Museum has the following species located from here:—

Astarte sp.
Crassatellites gracilis, Sowerby.
Gervillia Forbesiana, Sowerby.
Lucina sp.
Meretrix sp.
Modiola albensis (d'Orbigny).
Modiola aff. *subsimplex*, d'Orbigny.
Nucula albensis, d'Orbigny.
Pecten (*Syncyclonema*) *striatopunctatus* (Mantell).
Pholadomya sp.
Tellina sp.
Thetis minor, Sowerby.
Thracia sanctæ-crucis, Pictet & Campiche.

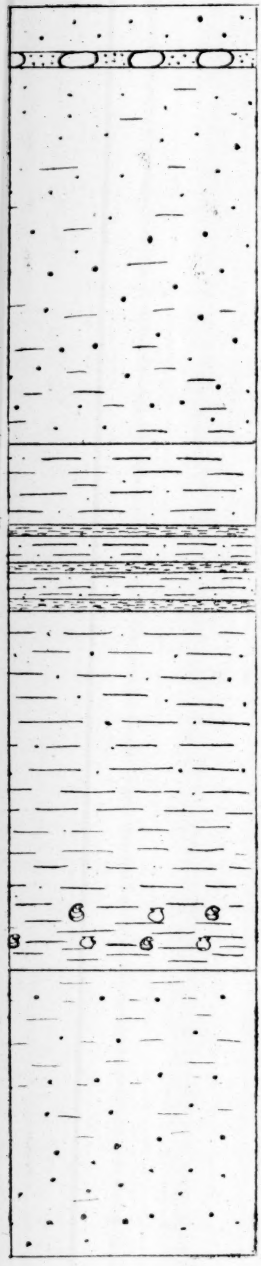
The following, too, have been found by the author, which are neither in the list in the Survey Memoir nor in the British Museum:—

Cuspidaria sanctæ-crucis, Pictet & Campiche.
Ostrea sp.
Avellana inflata, d'Orbigny.
Lingula subovalis, Davidson.
Shell of a Cirripede, ? *Scalpellum*, sp.

By far the commonest fossils are *Pecten orbicularis*, Sowerby, *Lima parallela*, d'Orbigny, and *Inoceramus concentricus*, Parkinson; but *Grammatodon carinatus* (Sowerby), *Pinna* sp., and a small Gasteropod, ? *Fusus*, were plentiful.

[1] R. B. Newton, "Cretaceous Zones in Dorset": Geol. Mag., 1896, p. 198, and Proc. Dorset Nat. Hist. and Ant. Field Club, vol. xviii (1897), p. 66.
[2] Jukes-Browne: loc. cit., p. 188.

FIG. 1. SECTION IN THE SELBORNIAN OF BLACK VEN.



Lowest layer of Cowstones.	
10. Grey, loamy, micaceous sand, with very little glauconite, and with small patches of bright red iron oxide; becoming more argillaceous lower down, and containing a few worm-tubes.	10 ft.
9. Blue, loamy, glauconitic clay, with a little mica. No fossils.	2 ft.
8. Very hard, shaly loam. A few fossils.	4 in.
7. Blue, loamy, glauconitic clay, with a little mica.	9 in.
6. Very hard, shaly loam. [No fossils.	4 in.
5. Blue, loamy, glauconitic clay, with a little mica.	9 in.
4. Very hard, shaly loam. A few fossils. [No fossils.	4 in.
3. Bluish-black loamy clay, containing a little mica, with fossils, becoming more argillaceous and much more fossiliferous lower down.	10 ft.
2. Dark-green glauconitic loam, becoming sandier lower down. No fossils.	8 ft. shown.
	32 ft. 6 in.

Zone of *Selenochlamys ventricosa*.

Zone of *Hoplites interruptus*.

Bed 3 is again exposed in two little sections a few feet high, about twenty yards further west. These yielded specimens of *Turritella*.

Beds 4, 6, *and* 8. These three beds are like each other, and in composition resemble closely the last bed and beds 5, 7, and 9, but differ from them in their structure, which is hard and difficult to break with the hammer, owing to the rock immediately beneath the hammer-head becoming pulverised and acting as a cushion to the rest of the mass. Moreover, it does not break along bedding-planes (though the existence of these can be seen on a weathered surface), but into irregular lumps. These beds are conspicuous on the face of the section, for being harder they weather back less quickly than those above and below them. They contain traces of fossils, and a cast of *Thetis minor*, Sowerby, was found in a fallen block from one of them, lying in the bog beneath the section.

Beds 5, 7, *and* 9. These beds are like the last in composition, only not indurated, but rather sticky and coherent. No fossils were found in them.

Bed 10. This bed ushers in sandy conditions again, being really a passage bed between this zone and the zone of *Schlœnbachia rostrata* above, which consists of slightly loamy sands throughout, its base being marked by the lowest layer of Cowstones. As this layer is approached, bed 10 becomes more sandy, being more argillaceous in its lower part and containing a few fossil worm-tubes. In places it is characterised by small bright patches of blood-red iron oxide.

To sum up:—On the face of Black Ven the total thickness of the zone of *Hoplites interruptus* is about 38 feet, and lies between 315 feet and 353 feet above sea-level. The whole is seen in two sections. The beds are loams with varying proportions of sand and clay. They are sandiest at the top, becoming more argillaceous on descending, the predominance of the clay reaching a maximum in bed 3, at about 15 feet from the base of the zone. The bottom few inches of the zone also contain much clay, and are characterised by an impersistent pebble bed. Fossils occur sparingly throughout the zone above bed 3, but become abundant at the base of this bed, simultaneously with the maximum amount of clay. The bottom two beds may represent the zone of *Acanthoceras mammillatum*, but there is not a particle of fossil evidence to justify the assertion.

NOTICES OF MEMOIRS, ETC.

I.—Singleness of the Ice Age.

(Die Einheitlichkeit der Quartären Eiszeit. Von E. Geinitz in Rostock. Aus dem Neuen Jahrbuch für Mineralogie und Palaeontologie. Beilage-Band xvi, S. 1–98. Stuttgart, 1902.)

He who attempts to collect, harmonize, and arrange into a scheme of classification the accounts of the North European Drift in separate areas is confronted with divergence of view in every direction. The number of Glacial and Interglacial periods, their

importance, their equivalence, all present difficulties. He finds adjacent and probably equivalent fossiliferous beds ranked differently by different authors; a series will by one be designated Interglacial which another calls no more than a local deposit of sand or clay. The latest researches in Quaternary geology have led to the following conclusions:—For Sweden it has been shown that the Ice Age there was single, unbroken by Interglacial periods. Examination of the moraines south of the Baltic shows that these are no boundaries of ice-extension, but only mark stages of retreat. The so-called 'First Ice Age' covered a narrower area than the 'Second or Principal Glaciation'; the 'Third,' again, less than the Second. Views on the importance of the 'Upper' and 'Lower' Boulder-clays are more and more extending the domain of the Upper. The list of the fossiliferous 'Interglacial beds' is continually increasing.

It must be remembered that while in the northern districts removals of material will have predominated, accumulations will have been the rule in the centre, fluvio-glacial formations in the southern border-region. Glaciers, and in like manner ice-floes and ice-packs, will have produced plentiful disturbances of beds.

Considering everything, the author is driven to the conclusion that "for the southern area of glaciation as for the northern, the whole Drift is to be treated as a single sequence, only broken by oscillations"; that "only one Ice Age has existed, instead of the supposed three (or four) sandwiched in with Interglacial periods of long duration. Consequently the facies accepted as intermorainic must be ascribed only to somewhat larger oscillations of the ice-front, not to periods wholly free from ice."

He quotes Holst's views on an elevation of Scandinavia, which would increase its glaciers; while the increase of ice would produce depressions; and discusses the probable sequence and consequences. Depressions would extend areas of submergence; connection with cold-water seas would bring deposits of Arctic forms; with warmer waters, temperate. On land, animals and plants would follow advances and retreats of the ice-front.

Discussing the records, he decides that "the fauna and flora of the Quaternary period indicate a climate like the present, only slightly warmer." But the mighty mass of ice affected climate, lowering it over North Europe. The northern ice advanced, with many oscillations, pushing forward especially into bays and valleys, leaving intervening areas free of ice. Consequent alterations of level would produce or remove submergences. Finally, the period of retreat seems a time of somewhat greater warmth than the present, and lasted considerably longer than the period of advance.

One may say that the Ice Age to a certain extent worked its own downfall—rise of Scandinavia and vast development of glaciers; consequent depression; access of warm currents and rise of temperature; commencement of melting.

The same considerations are applicable to Great Britain, where the marine deposits, in close relation to the Boulder-clay, play a yet more important part.

The author proceeds to give reasons for these views. Under a heading "First and Third Ice Age," he discusses the formations which have been attributed to these. There is no characteristic, he says, which can be relied upon for assigning a particular Boulder-clay to the Upper or the Lower Drift.

He enumerates and discusses in detail "the Fossiliferous Drift Deposits of North Germany and Denmark," classifying them as—(1) Lacustrine deposits: (*a*) Pre-Glacial, (*α*) River, (*β*) Subsidence deposits (these, he remarks, collectively lie along a line which he describes); (*b*) Interglacial fresh-water formations, (*α*) Peat-beds, (*β*) Diatom-beds, (*γ*) Beds with fresh-water shells. (2) Marine Diluvium or Pleistocene Drift: (*a*) Cimbrian Peninsula (the occurrences collectively indicate an extension of the Elbe Estuary 100 km. inland from Hamburg, also access of the North Sea to the Baltic, affecting Möen and Rügen); (*β*) Prussian Province (the occurrences collectively indicate an arm of the sea extending into the heart of East Prussia).

A folding page at the end gives the Author's Scheme of Interpretation:—(1) Rise of the Scandinavian Archæan massif, increase of ice, and production of the Norwegian and Baltic Ice-stream. (2) Floes and bergs in Atlantic and Baltic, with deposit of various materials. (3) Advance of ice into Germany. (4) Ice reaching maximum extension in Holland, Saxony, Silesia, Central Russia. Then a short period of rest. (5) Long period of melting, leaving remains of terminal moraines. (6) Further retreat of the ice, leaving well-known terminal moraines of the Baltic ridges. (7) Retreat to the Scandinavian *terra firma*. (8) Circumstances of to-day. A map marks the positions and natures of fossiliferous localities, lines of terminal moraines, areas indicating marine submergence, and southern limits of glaciation. E. H.

II.—International Geological Congress.

1.—Report of the Commission on International Co-operation in Geological Investigation laid before the International Geological Congress at Vienna in 1903. By Sir Archibald Geikie, President of the Commission.

HAVING been appointed at the last Congress to preside over the Commission formed at Paris in 1900 for international co-operation in geological research, I wrote individually to each of the members of this Commission asking them to be good enough to give me their views and suggestions on the subjects submitted to our consideration. To these letters I have only received two replies. I cannot therefore to-day—and it is to be regretted—submit to the Congress the conclusions of the full Commission. Nevertheless, the importance of the subjects proposed is such that it justifies me in recapitulating them to you. The questions submitted to the Commission were the following:—(1) What are the branches of geological research in which international action appears the most desirable; and (2) what are the best means of ensuring uniformity of method in the investigations?

1. With regard to the first of these questions it is obvious that international co-operation may be profitably adopted for the consideration of problems connected with dynamical geology—such as earthquakes, the movements of the terrestrial crust, the course, fluctuations and geological functions of glaciers, the rate of progress of denudation under the action of epigene agents in different climates.

2. The reply to the second question ought to be treated from two points of view. In the first place, there are international scientific investigations which by reason of their special character ought to be undertaken by geologists properly so called. For this kind of research the Congress has only to follow the lines already laid down by it, and the end will be attained by the organization of special commissions similar to those now in operation for the geological map of Europe, glaciers, petrography, which have already obtained such important results. New special commissions may have to be appointed, but this is not the place to propose them.

But there is a second series of international researches of capital importance to geology, the prosecution of which appears to me to require an organisation and resources superior to those of our Congress. For some years several scientific Associations have existed which, like our own, have proposed international combination for the furtherance of different branches of science. I think our Congress might profit by this tendency, and endeavour to effect a collaboration for the study of the problems which interest us and whose solution involves varied technical knowledge and considerable expense. Thus it is a problem of the greatest interest to geologists, whether a chain of mountains subject to earthquakes undergoes at the same time slow movements of elevation or depression. The solution of this question necessitates particular measurements, both numerous and prolonged. But why should geologists undertake it alone? It is as interesting for geodesists as for geologists; the accuracy of their methods would be most valuable to us. Now there already exists an "International Geodetic Association," established for the study of the shape of the earth. Why should we not seek the co-operation of our colleagues for investigations like these, where geodesy plays an all-important part, but which have also great geological value? On the other hand, since the Geological Congress met at Paris the "International Association of Academies," composed of delegates from all the Academies of the world, has been founded. It has the double object of co-ordinating scientific investigations and of obtaining from the Governments of the different countries definite and effectual support. This powerful Association appears to be so well adapted to deal with international scientific questions that we may well ask ourselves if it would not more easily and fully than our Commission determine the questions that I have submitted to the Congress.

If such should be your opinion, and the Congress should judge it fitting to apply to the "International Association of Academies," I would suggest that a Committee be appointed to define the

geological researches to be undertaken and to indicate the methods suitable for arriving at the desired end.

This programme, sanctioned by the authority and prestige of an International Geological Congress, would be submitted to the International Association of Academies at its next meeting, which will be held in London at Whitsuntide, 1904.

2.—Report of the Commission on the Raised Beaches of the Northern Hemisphere. Presented to the International Geological Congress at Vienna in 1903, by Sir Archibald Geikie, President of the Commission.

The Commission submits the following propositions for the consideration of the Congress :—

1. Hitherto the height of old coastlines (raised beaches) has been measured from high-water level, mean sea-level, from the zone of *Fucus*, etc. But no one of these boundaries is precisely defined, and they vary perceptibly in the same district. To determine them exactly it is necessary to have a point or level for each country cut, or marked in some durable manner, on the solid rock near the high tide. From this fixed point all the altitudes along the coastline should be measured or calculated.

2. Note should be taken of all the possible variations of the mean level of the sea, and to this end the archives of the ports should be consulted.

3. The height of a raised beach or strand-line should always be calculated from its interior or superior margin, where this is visible, but the height of the exterior or inferior edge should also be given when it can be observed, as an indication of the extent of tide at the time of that coastline.

4. It is important to follow the horizontal extent of a coastline from one end of a country to the other.

5. The variations in altitude of a coastline should be measured in two directions where that is possible : (1) along the coast, i.e. parallel to the axis of a country; (2) transversely to this axis, in the bays or fjords.

6. It should be ascertained if a coastline or a series of these lines disappears in a given direction, and the conditions under which this disappearance takes place should be exactly stated. In Scotland, for example, the raised beaches, so clearly defined along the west and east coasts, disappear towards the northern extremity of the kingdom in the county of Caithness, and in the islands of Orkney and Shetland.

7. The diversities of character in a line of raised beach deserve to be registered. Parts have perhaps been cut in the solid rock (*seter* of Norway), others have been formed of deposits of detritus. The relations of these diversities to the contours and to other varieties of topographical configuration should be examined.

8. In a successive series of raised beaches it is important to determine with precision their relative variations in level, in such a manner as to demonstrate whether or not the movements to

which they owe their origin have been unequal, and to show the direction of these inequalities. Differences in the depth of the erosion of the solid rocks and in the breadth and the thickness of the detritic deposits should also be noted.

9. It is obvious that great importance attaches to the organic remains of the raised beaches. Not only should the detritic deposits be carefully looked over, but research should also be made in the rocky platforms, the cliffs, and caves, where one might find boring shells, cirripedes, or adherent corals.

REVIEWS.

I.—The Marine Tertiary Fauna of America and Europe. By Clement Reid, F.R.S.

THE completion of Professor W. H. Dall's monograph on the Tertiary Fauna of Florida, begun in 1885, places in our hands exceedingly valuable material for the study of certain problems that have much exercised European geologists.[1] It is at last possible to make some sort of comparison between the molluscan faunas inhabiting the two sides of an ocean in Tertiary times; fresh light is thrown on the vexed question of the connection or isolation of the Atlantic and Pacific Oceans at various periods; and incidentally we may perhaps learn something as to the former course of the Gulf Stream.

We are not prepared to criticise, and it is impossible to analyse in detail, the descriptions of the mollusca in so large a monograph. Attention should be drawn, however, to the beautiful way in which the book is printed and illustrated; and we must congratulate the Wagner Free Institute on the high standard which has been kept up. The only complaint that might be made from an artistic standpoint is that the numerous plates look perhaps a trifle hard. But anyone who has worked much at the critical determination of closely allied species will recognise that this, if a fault at all, is a fault on the right side; these illustrations, for scientific purposes, are far better than the soft and somewhat woolly lithographs to which we often have to refer.

The deposits which yield the mollusca range in time from Eocene to Pliocene, and include various strata on the western side of the Atlantic besides those of Florida. Almost all the species differ from those of Europe; and thus they do not support the idea, suggested by a study of the echinoderms, that during Oligocene times the Mediterranean region may have been connected with the Antilles by a continuous coast or belt of islands.

The discordance between the mollusca and the echinoderms, just referred to, raises a question of some interest. Is it not a discordance

[1] "Contributions to the Tertiary Fauna of Florida," by Professor W. H. Dall, Wagner Free Institute of Science, Philadelphia, pp. 1620 and pls. lx (1890–1903).

between free-swimming and sedentary forms, or rather between sedentary forms and forms that go through a floating or free-swimming stage lasting some time? On looking through Professor Dall's monograph we are disappointed to find, though it is no fault of his, that practically the whole of the molluscan faunas described consist of sedentary forms. If we could compare the pteropods, *Ianthina*, ship-worms, barnacles, sharks, and such like on the two sides of the Atlantic, we should probably discover the true 'Atlantic' fauna for each period, which would leave no doubt as to the exact correlation. At present, for instance, we only know the American and European Eocene faunas of the shallow seas, we are only slightly acquainted with the true Atlantic Eocene fauna. In time these gaps will be filled up, and we shall be able to correlate with greater certainty.

The careful and sober account of the physical changes in the Antillean region, given in the "Discussion of the Geology" (pp. 1541–1620), needs close study and cannot easily be condensed; it is in striking contrast with much of the wild speculation that has been rife. The physical and climatic changes are traced step by step, evidence being given for each statement. In Eocene times the two oceans were separate. The Oligocene deposits of Florida are of enormous thickness, and there is evidence of a connection between the Atlantic and the Pacific. In Miocene times the two Americas became again connected, and the fauna of the Gulf coast changes completely. "The change was not only in the species and prevalent genera of the fauna, but a change from a subtropical to a cool temperate association of animals. Previously, since the beginning of the Eocene, on the Gulf coast the assemblage of genera in the successive faunas uniformly indicates a warm or subtropical temperature of water. . . . . With the incursion of the colder water the change becomes complete. Not only do northern animals compose the fauna, but the southern ones are driven out, some of them surviving in the Antilles to return later. Some change along the northern coast permitted an inshore cold current to penetrate the Gulf. . . . ." A cool Miocene sea in the Gulf of Mexico is a phenomenon which will have to be taken into account by the student of geographical distribution. In conjunction with a temperate Miocene climate in the Arctic regions it may help to explain the occurrence of closely allied land-animals and plants on the two sides of the Atlantic, and in the northern and southern hemispheres.

As to subsequent changes, Professor Dall writes: "I concur with Hill in the belief that, whatever changes of level may have taken place since, no discontinuity of the link between North and South America from the Miocene to the present time is probable, and certainly none amounting to a free communication between the two oceans."

Towards the close of the Miocene period Florida became united to the continent, and the influx of cold water into the Gulf of Mexico ceased. Gradually the temperature rose, and the exiled

subtropical species began to return; a still warmer sea-temperature inaugurating the Pliocene. "The end of the Pliocene is the beginning of the Glacial epoch. The Pleistocene of Florida shows a change for a cooler and an elimination of the most purely tropical forms from the fauna, but nothing like the clean sweep at the beginning of the Miocene. The latter is the sharpest and most emphatic faunal change since the Cretaceous on our coasts." The curious discordance between Tertiary climatic changes, as evidenced in America and as recognised in Europe, is a striking commentary on any attempts to trace secular climatic variations in successive faunas in a limited district. The influence of changes in physical geography must be enormous: but probably in the case of Florida quite exceptional, as is recognised by Professor Dall. One wonders, however, whether any echo of these geographic changes reached our shore, diverting ocean currents and perhaps reversing the climatic changes on this side of the Atlantic.

REPORTS AND PROCEEDINGS.

I.—Geological Society of London.

1.—January 6th, 1904.—Sir Archibald Geikie, D.C.L., D.Sc., Sec. R.S., Vice-President, in the Chair. The following communications were read:—

(1) "On a Palæolithic Floor at Prah Sands, in Cornwall." By Clement Reid, Esq., F.R.S., F.L.S., F.G.S., and Eleanor M. Reid, B.Sc.

Prah Sands lie about 7 miles east of Penzance, and have long been known as exhibiting a good section of 'head' or rubble-drift over raised beach, which rests on a wave-worn rocky platform. Recent storms have cleared away the talus at the foot of the cliff, and have exposed, between the 'head' and the raised beach, a Palæolithic land-surface, consisting of loamy soil penetrated by small roots. In and above this occur black seams full of small fragments of charcoal and bone; these are particularly abundant round groups of large flat stones, which seem to have formed ancient hearths. The black seams contain implements made of vein-quartz. For a few feet above this land-surface the angular 'head' consists mainly of loam with fragments of vein-quartz, some of which are worked. This seems to be the first record of Palæolithic man in Cornwall.

(2) "Implementiferous Sections at Wolvercote (Oxfordshire)." By Alexander Montgomerie Bell, Esq., M.A., F.G.S.

This section shows the following beds:—(1) Oxford Clay; (2) old surface, in which are pits or troughs chiefly filled with gravel and enveloped in weathered clay; (3) a large river-bed, containing gravel at the base, and layers of clay above; (4) Neolithic surface-layer, 2 feet thick. The gravel of the river-bed contains quartzite pebbles, some of exceptional size, and is covered by a thin lenticular layer of peat and sand, yielding thirty flowering plants and many

mosses; the clays over this have probably been formed in a lake, possibly due to a beaver-dam. In the gravel-bed are found implements formed of flint quarried from the Chalk, or of quartzite from pebbles of the Northern Drift, all remarkable for their size, beauty, and freshness, together with the remains of large mammals, including the mammoth. The old surface, from which the river-bed has been eroded, has also yielded implements associated with quartzites, quartz-pebbles, and lydianstone, gravel from the Thames Valley, limestone pebbles, Oolitic fossils, and sand. This deposit is regarded as remanié from the Northern Drift, probably laid down under the action of ice, as shown by the flask-like shape of the pits, the vertical position of some of the pebbles, and the jamming-in of masses of sand, probably in a frozen condition. Further, the Oxford Clay beneath the surface is weathered and shaken to a depth of 10 or 12 feet, except where cut off by the descending depth of the river-bed. The implements are small, ordinary in shape, and made of flint, not quarried, but mostly taken from the Drift, and they are much weathered, stained, and patinated. The occurrence of an older set of implements, differing so markedly from those of the river-drift, leads the author to explain the peculiar implementiferous drift of Iffley as containing implements of two kinds and two dates. Those that are unweathered are contemporaneous with the deposit, and like those of the Wolvercote river-bed; while those that are stained with ochre, or deeply patinated, have been derived, like the Oolitic fossils, Tertiary conglomerate, quartzites, and volcanic rocks, from an older deposit. The author believes that the frequent occurrence of weathered and unweathered implements in a single deposit may be explained generally in this way; and he further infers that the time between the Drift and the river-bed was prolonged, and that the interval may have been as long as that which separates the epoch of the river-bed from the present day, his evidence being simply the patination of the flints. In conclusion the author suggests that there are three classes of implement-bearing drifts, the ice-drifts being the earliest and the river-drifts the latest, while the wash-drifts may belong to more than one stage.

2.—January 20th, 1904.—Sir Archibald Geikie, D.C.L., D.Sc. Sec.R.S., Vice-President, in the Chair.

The Secretary announced that the Council had communicated the following resolution of sympathy to Mrs. Etheridge:—

"That the Council desire to place on record their great regret at the death of Mr. Robert Etheridge, F.R.S., formerly President of this Society, who did so much during his long life to advance Geological Science and to promote the interests of the Society."

The following communications were read:—

(1) "On the Jaws of *Ptychodus* from the Chalk." By Arthur Smith Woodward, LL.D., F.R.S., F.L.S., F.G.S.

Hitherto no traces of the cartilaginous jaws of this fish have been found in association with the dentition; but Mr. Henry Willett

has recently found a specimen of *Ptychodus decurrens* in the zone of *Holaster subglobosus* of the Lower Chalk at Glynde (Sussex). Fragmentary remains of both jaws are seen in the specimen, each bearing many of the characteristic teeth arranged in natural order. There are four series, and one small displaced tooth (probably belonging to the fifth series), on the left of the large median series in the lower jaw; while in the upper jaw the teeth are clearly arranged in six paired series. The specimen proves that the peculiarly effective disposition characteristic of the living Myliobatidæ had not been assumed, but that *Ptychodus* more nearly resembled the Trygonidæ in its jaws. The probable explanation of the new discovery is, that in the Cretaceous Period the great rays of the 'families' Myliobatidæ and Trygonidæ had not become fully differentiated. Professor Jækel has already arrived at a similar conclusion from general considerations, and has proposed to place all these fishes in one comprehensive family, termed Centrobatidæ. If this arrangement be adopted, *Ptychodus* represents a primitive sub-family, which still awaits definition from lack of complete specimens; while the Trygoninæ, Myliobatinæ, and Ceratopterinæ are equivalent sub-families which survive at the present day.

(2) "On the Igneous Rocks at Spring Cove, near Weston-super-Mare." By William S. Boulton, Esq., B.Sc., A.R.C.S., F.G.S.

A traverse from end to end of the exposure at the locality shows that the 'basalt-mass' varies in structure and appearance, and that it is by no means a simple lava-flow. It may be roughly divided into three portions. Beginning at the cliff end to the north, the rock for the first 30 yards is a pillowy basalt, with tuff and limestone often occupying irregular spaces between the spheroids of amygdaloidal basalt; then, for about 20 yards, the rock is mainly a coarse 'agglomerate,' with lapilli and bombs of basalt and limestone; while the remaining 100 yards or so is an ordinary basalt-coulée, with very few and always small lumps of burnt limestone. The limestone below is reddened and altered, and although tuffy-looking, does not contain indubitable lapilli; the limestone above contains lapilli. The pillowy basalt probably represents a river of agglomeratic material carrying finer lapilli, larger and plastic masses of scoriaceous basalt, and lumps of limestone, possibly ejected from a vent. The intervening tuff may present an analogy with the 'volcanic sand' of the West Indian eruptions. There is no evidence of the quiet deposition of ashy material, but rather of the tumultuous aggregation of a fluxion-tuff taking place under some depth of sea-water. The large and irregular fragments of limestone, oolitic and fossiliferous, found mainly in the lower part of the basalt-mass, have not come in from above through cracks in the lava, but seem to have been picked up while in a soft and powdery state from the sea-bed in which it had been accumulating, and to have been involved with and altered by the volcanic material. The conditions existing in submarine flows appear to be very like those in a sill or intrusive sheet.

3.—February 3rd, 1904.—Sir Archibald Geikie, D.C.L., D.Sc., Sec. R.S., Vice-President, in the Chair. The following communications were read:—

(1) "On a Deep-Sea Deposit from an Artesian Boring at Kilacheri, near Madras." By Professor H. Narayana Rau, M.A., F.G.S.

The village of Kilacheri is about six miles due south of the railway station of Kadambattur. Here permeable beds of sandstone and felspathic grits dip at low angles seaward, and are overlain by impervious clays and shales. The boring, after penetrating the upper clays and sandstones, passed through carbonaceous shales, and at a depth of about 400 feet reached a blue homogeneous rock, effervescing with acid and showing radiolarian tests under the microscope. Most of the latter display the inner reticulate structure in thin sections, and some of them, when isolated, show radiating spines as well; they are, however, not capable of specific determination. One or two specimens of foraminifera have also been seen. The deposit underlies beds of the Upper Gondwâna Stage. The bed also contains palagonite, volcanic glass, pumice, mineral fragments (such as plagioclase, quartz, augite, and possibly hornblende), and black metallic spherules of iron and manganese. The last sometimes partly fill the radiolarian tests, and sometimes encrust the pumice and palagonite; they give the manganese reaction with a borax-bead. The author concludes that the deposit is of truly abysmal origin, similar to those described in the "Challenger" Reports; and he points out the remarkable interest of such an occurrence in Peninsular India, a region which appears to have been a land-area since Palæozoic times.

(2) "The Rhætic Beds of the South Wales Direct Line." By Professor Sidney Hugh Reynolds, M.A., F.G.S., and Arthur Vaughan, Esq., B.A., B.Sc., F.G.S.

After a reference to the literature of the subject the following exposures are described: the Stoke Gifford and the Lilliput or Chipping Sodbury sections. From the first section the Bone-bed is completely absent. The beds here rest upon tea-green marl, and are covered by the Cotham Marble. A section to the east of Lilliput Bridge shows two large rounded hummocks of Palæozoic rock projecting into the Rhætic, and in both cases the Black Shale is deposited on it in an arched manner, forming an anticline of deposition. There is also a very rich Bone-bed at the base, which is not uniformly distributed. The upper beds correspond with those of Stoke Gifford. In correlating these rocks with those of neighbouring areas, a table of general sequence is given, in which the Lower Rhætic is divided into three and the Upper into two stages, which are correlated with the notation of Richardson and Wilson. This is followed by a range-table of the typical Rhætic mollusca: *Cardium rhæticum* and *C. cloacinum*, *Schizodus Ewaldi*, *Pecten valoniensis*, and *Avicula contorta*. Palæontological notes on the invertebrata and vertebrata follow. New species of *Anomia*, *Plicatula*, *Modiola*, and *Cardinia* are described; notice is given of

other Rhætic mollusca; and a range-table is appended of the commonest mollusca that occur at Sodbury and Stoke Gifford. The reptiles, amphibia, and fishes referred to are all known species. A general account is given of the distribution of the Bone-bed in the Bristol district. In Somerset, except at Emborough and Watchet, no true Bone-bed has been recorded; in the district immediately north of Bristol there is a single, well-marked Bone-bed at the base of the Black Shale series, or very slightly above it; while in the Gloucester district the principal Bone-bed tends to lie at a greater distance from the base of the Black Shales. For these reasons, the authors think that the principal Bone-beds in the various sections cannot be regarded as homotaxial equivalents.

II.—Mineralogical Society, Feb. 2nd, 1904.—Dr. Hugo Müller, F.R.S., President, in the chair. Mr. Harold Hilton contributed a paper on the Gnomonic net. This net consists of lines giving equal longitudes and latitudes for every ten degrees on a plane touching a point on the equator, the former being hyperbolæ and the latter straight lines. The author pointed out how the net could be used for the graphical determination of angles between poles on the sphere.—Mr. G. T. Prior described a new sulphostannite of lead from Bolivia, to which he gave the name Teallite, in honour of the Director of the Geological Survey. The mineral in its graphite-like appearance resembles franckeite and cylindrite, but differs from them in not containing antimony. It has the simple formula $Pb\,Sn\,S_2$, and is orthorhombic with angles $c\ (001) \wedge o\ (111) = 62°$, $c\ (001) \wedge p\ (221) = 75°$, and $m\ (110) \wedge m'''\ (1\bar{1}0) = 86°$. It has a perfect cleavage parallel to c (001), and a specific gravity of 6·36. In connection with the investigation of this mineral, new analyses were made of franckeite and cylindrite.—Mr. W. F. Ferrier gave an account of his discovery of deposits of corundum in Canada; and Professor H. A. Miers described a visit to the Rashleigh Collection of Minerals now deposited in the Museum of the Royal Institution of Cornwall at Truro.

CORRESPONDENCE.

MR. A. G. M. THOMSON'S BOOK ON THE OLD RED SANDSTONE.

Sir,—Without dissenting from the opinions expressed by your Reviewer (this vol., p. 84, Feb.), may I suggest that the expression of them is not quite fair? You give the name of John Leng & Co., Dundee, as that of the publishers, and you "can only wonder why such a work has been published." I have, however, the highest authority for stating that the work has not been published, but distributed privately, as a gift by the author, while Messrs. Leng are only the printers. It seems to me that the proper way to treat unpublished communications is to ignore them: if such a course be agreeable to the author, well and good; but if it is not agreeable to him—so much the better!

Bibliographer.

ABSENCE OF *LEPUS EUROPÆUS*, PALLAS, FROM BRITISH PLEISTOCENE DEPOSITS.

Sir,—Having had an opportunity of examining the remains of Hares from the Pleistocene of this country, preserved in the Natural History Museum, I find that all the specimens which are determinable, including the originals of Buckland's and Owen's figured specimens, belong to the Mountain Hare (*Lepus timidus*, L.), there being no evidence of the common Hare (*Lepus europæus*, Pallas). In consequence, I am inclined to assume that the latter has been introduced into this country by man, possibly as late as the Roman period. I ask you kindly to give publicity to this letter in the hope that if there is conclusive evidence of Pleistocene remains of the *Lepus europæus* in some public or private collection it may be forthcoming.

C. I. Forsyth Major.

OBITUARY.

WILLIAM VICARY, F.G.S.

Born July 26, 1811. Died October 22, 1903.

William Vicary was born in 1811 at Newton Abbot in Devonshire. Early in life he removed to North Tawton, where he started business as a tanner, and with so much success that he retired in 1856 and removed to Exeter, where he resided for the remainder of his long life. He was one of the founders of the Devonshire Association, established in 1862, and an original contributor to Symons' "British Rainfall," the first volume of which, for the year 1860, was published in 1861. He was elected a Fellow of the Geological Society of London in 1864. Mr. Vicary was an enthusiastic collector of fossils, and his museum was especially rich in the fossils from the Upper Greensand of the Haldon and Blackdown Hills. He is best known to geologists by his discovery of fossils in the quartzite 'popples' of the Triassic pebble-bed of Budleigh Salterton. The fossils were described and figured by Salter in a joint paper brought before the Geological Society, while Salter dealt more generally with the subject in the first Original Article published in the Geological Magazine (July, 1864). The species, all new to British geology, were identified with forms found in the older rocks of Normandy, some belonging to the *Grès Armoricain* (Arenig group). Mr. Vicary's valuable collection, embracing a large number of type-specimens, was bequeathed by him to the Natural History Museum, Cromwell Road.

1864. "On the Pebble-bed of Budleigh Salterton"; with a Note on the Fossils by J. W. Salter: Quart. Journ. Geol. Soc., vol. xx, p. 283.

1865. "On the Feldspathic Traps of Devonshire": Trans. Devon Assoc., vol. i, p. 43.

1867. "On the Source of the Murchisonite Pebbles and Boulders in the Triassic Conglomerates of Devonshire": Trans. Devon Assoc., vol. ii, p. 200.

1872. "Fossil Coral allied to *Meandrina* (Ehrenberg), from the Upper Greensand of Haldon Hill, near Exeter": Ann. & Mag. Nat. Hist., ser. iv, vol. ix, p. 84.